



VERTICAL AXIS WIND TURBINE
AND WIND PROSPECTING SITE
DATA ANALYSIS
FINAL REPORT
FOR 1986

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1. INTRODUCTION

In order to assess the potential for generation of electricity from wind power, Energy, Mines and Resources Canada has established a number of wind prospecting sites across Canada. Wind regime data was collected in the form of a wind speed profile at each site. The objective of the project was to reduce and analyse this data and present the results in a form that would facilitate comparison of data between sites and data collected by other agencies.

Data from three Vertical Axis Wind Turbine (VAWT) energy generating sites was also processed. At each VAWT site wind regime and turbine performance data was collected, reduced and analysed. This provided a means of comparing turbine performance with wind regime data and potential energy generation calculations.

This C697-Final Report summarizes the work carried out during the contract period, June 1986 through March 1987.

2. DESCRIPTION OF WORK

The following describes the work performed during the period covered by this contract. The various aspects have been divided into three main categories which are as follows:

1. Data Entry and Processing
2. Technical Summary
3. Additional Tasks

2.1 Data Entry and Processing

Histogram data from the installed recorder and a short report detailing any associated site problems are recorded by local personnel at each site every month. This data is mailed to T E S Limited for monthly processing.

Data received at T E S Limited are checked for operator's notes pertaining to the operation of the recording equipment. A site which indicates a problem either by an operator note or by obvious errors in the data, is contacted to determine replacement equipment needs.

Sites failing to submit a data log by the middle of the current month are considered delinquent if that data log does not include data up to the middle of the previous month. These delinquent sites are contacted in an effort to accelerate the data transfer process. A site status report is prepared and sent to the EMR Project Officer listing those delinquent sites.

Site data as received is entered, sorted, and reduced on the T E S computer system. The results of the reduction are output in the form of one data table listing calculated figures such as average wind speed, Weibull Shape parameter K, and estimated performance figures. In addition a plot of wind distribution representing the duration of the wind in a given wind speed range and a plot of the

cumulative frequency distribution are plotted. For those sites which have a turbine, a further two plots are included. These plots represent Actual versus Estimated Output Energy in the form of a bar chart and a plot of Percentage Availability, also a bar chart. Appendix B shows a typical monthly data reduction output.

Data from the reduction is checked and entered on the respective Site Performance summary sheet and submitted, with the associated notes and graphs, to EMR in the form of a monthly report.

The number of sites on stream during 1986 fluctuated to a maximum of 10 (7 prospecting, 3 generating). Each site manager was sent those sections of the monthly report which contained information and results from sites in their area. The format of the monthly reports changed very little during this contract period. Site Logs were updated for each site included in the Field Trial. These logs summarize those monthly notes of difficulties and operational problems as reported to T E S Limited by the site operators.

In conjunction with the monthly report a table is prepared from data collected from the three vertical axis wind turbine trial sites. This table, entitled "Wind Energy R & D Program 50 kW VAWT Field Trial Systems Cumulative Summary", (Appendix C) summarizes the net power produced, generating time, and rotor idling time for each VAWT site.

To date, information has been received and processed for the various sites covering the periods as listed in Table 1.

Table 2 lists all sites reporting data during the 1986/87 contract period and the status of the monitoring equipment at each site.

Table 1 - Data Received From Sites to Date

<u>Site Name</u>	<u>Data Period</u>
Atlantic Test Site	Aug. 1982 - Sep. 1986
Cambridge Bay	Dec. 1983 - Jul. 1985
Christopher Point (generate)	Nov. 1980 - Mar. 1987
Christopher Point (middle)	Nov. 1980 - Mar. 1987
Churchill (generate)	Feb. 1982 - Mar. 1987
Churchill	Feb. 1982 - Mar. 1987
Rankin Inlet	Oct. 1984 - Mar. 1987
Rattlesnake Hill	Sep. 1986 - Mar. 1987
Swift Current (generate)	Aug. 1980 - Mar. 1987
Swift Current	Aug. 1980 - Mar. 1987
Ste. Anne Universite	Sep. 1986 - Mar. 1987
St. Anthony	Mar. 1986 - Mar. 1987
EMR (Vancouver)	Installation not complete

Table 2 - Site Status

<u>SITE NAME</u>	<u>EQUIPMENT</u>	<u>STATUS</u>
Atlantic Test Site	WHR/ANEM/CUPS	Removed (returned to T E S)
Cambridge Bay	WHR/ANEM/CUPS	Installed (inoperative)
Rankin Inlet	WHR/ANEM/CUPS	Installed
Rattlesnake Hill	WHR/ANEM/CUPS	Installed
Christopher Point	3 WHR/ANEM/CUPS	Installed
Churchill	2 WHR/ANEM/CUPS	Installed
Ste. Anne Universite	WHR/ANEM/CUPS	Installed
St. Anthony	WHR/ANEM/CUPS	Installed
Swift Current	2 WHR/ANEM/CUPS	Installed

WHR - DAF Indal Wind Histogram Recorder

ANEM - Climet Anemometer (#011-3)

CUPS - Climet Cup Set (Stainless Steel)

2.2 Technical Summary

The Technical Summary is a separate document in which data and analyses resulting from this project are summarized for the 12 month period January 1986 through December 1986 and related to other work in the wind energy field. It also includes several derivations of formulas, definitions and descriptions of various parameters used throughout this work.

This report was submitted as T E S Limited Report No. C697-13 entitled 1986 Site Technical Summary Vertical Axis Wind Turbine and Wind Prospecting Program.

Appendix A gives an example of the technical summary report format for a typical generating site. Formulas for the calculation of each parameter were provided by the National Research Council of Canada (NRCC). The derivation of each formula is traced in the Technical Summary.

2.3 Additional Tasks

In addition to the normal monthly data entry, processing, and report generation, T E S Limited undertook tasks at the request of the EMR Project Officer.

2.3.1 Westinghouse WR84 Recorder Communication Software

The need to monitor wind regime and energy data at a remote WECS site, was identified by the EMR project officer. A Westinghouse WR84 datalogger was to be supplied to EMR and programmed to collect the required data. An additional task was created under this contract, to provide to EMR a software program that would execute on an IBM (or compatible) personal computer, to remotely program and interrogate the Westinghouse recorder. The program was designed to communicate with the Westinghouse recorder using

a 300 baud telephone modem link and to place the received data into a disk file that could be reviewed and manipulated by a standard electronic spreadsheet program such as LOTUS 1-2-3.

A user manual was supplied with the program and is included as Appendix H of this report.

3. TECHNICAL DISCUSSION

The following paragraphs discuss major areas of interest concerning VAWT field trials and wind energy data analysis performed by T E S Limited.

3.1 Wind Speed Distribution

Wind speed distribution data was collected at the various sites using a calibrated cup and anemometer set and an electronic histogram recorder. During the period of this contract all sites used stainless steel cups. This cup anemometer, and histogram recorder combination provided a means of recording time spent in various wind speed ranges. These wind speed ranges varied in width, hence it was necessary to normalize data from sites to remove this differing factor. This resulted in a smoother distribution where the area of each bar is proportional to the time that the measured wind speed was within the bounds of a given wind speed range.

The formula for converting the ordinate of this histogram is as follows:

$$y(x) = \frac{P \cdot C(x)}{w(x)} \times \frac{1}{60} \quad (\text{min/bin width})$$

where x = bin number (representing a small wind speed range)
m/sec

y(n) = ordinate of the histogram at bin "x"

C(n) = number of recorded counts in bin "x"

P = histogram sampling period (2 seconds)

w(n) = width of bin "x" as defined by cup type and preset bin definitions in the recorder

3.2 Turbine Theoretical Energy

Two turbine power curves were supplied by the staff of NRC for the two different vertical axis wind turbine models currently in use.

Turbine theoretical energy was obtained by multiplying the ordinates of the bins in the generating range by the associated instantaneous power values obtained from the turbine power curves. These values were then summed and the appropriate air density compensation factor applied.

Theoretical energy calculations were also made for prospecting sites where there was no turbine. The Churchill turbine power curve was used as the model for the energy calculations at prospecting sites. The accuracy of the turbine power curves may be evaluated by comparisons of theoretical energy with actual energy generated at VAWT sites. These energy calculations will be more useful when accurate turbine power curves have been established.

The effect of the wind gusts is not included in these calculations as the wind speed distribution contains no time domain information.

3.3 Betz Limit

The Betz limit, often referred to as available wind energy, was calculated using the following equation.

$$\text{Betz limit} = \frac{8\rho AV^3 t}{27} \quad (\text{kWh})$$

where A = Turbine area (m^2)
 V = Wind Speed (m/s)
 ρ = Density (kg/m^3)
 t = Operational time (h)

The Betz limit is often given in terms of power but in the above case units of energy were obtained by multiplying by time (t).

Since the Betz limit is a measure of available wind energy it can be used in calculations of turbine efficiency. When using the Betz limit in turbine efficiency calculations it must be remembered that present turbine control systems cannot be designed to take advantage of all wind energy within the operational limits of the turbine.

3.4 Data Collection Problems

Due to the remote location of some prospecting sites, data is not always recorded at strict monthly intervals. In some cases the time period can extend beyond four months, making direct monthly site comparisons of wind data difficult. It is possible to divide recorded data from large time periods into monthly segments based on previously recorded site characteristics, however, the resulting information would merely be an estimate and hence could not be fully used for site-to-site comparisons.

4. RECOMMENDATIONS

The following paragraphs discuss recommendations and possible changes to the present method of analysis and reporting.

4.1 Histogram Drawings

In its present form, the presentation of wind speed data shows the form of the wind speed distribution. These histogram drawings may be compared between sites. The area of each bar indicates the duration in minutes that the wind speed was within the bounds of the bin. The total area of the histogram is the duration in minutes that the histogram recorder was in operation. Thus, for longer intervals the area is larger than for shorter intervals.

Since data reporting periods vary somewhat from site to site and from month to month, the areas of the various histograms do not strictly reflect the relative wind energies of various sites.

A refinement to the presentation of the wind speed histogram could be the elimination of the effects of the varying operational periods. This could be achieved by dividing the ordinate by the total time in the period. This is often referred to as a relative frequency density distribution.

4.2 Data Reduction

Currently data received for periods extending beyond the normal one month period are processed as received. The output from this data reduction contains a histogram plot spanning the entire time period, making monthly site comparisons difficult.

Data received for these larger time periods may be divided by weighing bins against known site characteristics for the months over which the recorded data spans.

The weighing of bins would be based on the site's known characteristics and would include:

1. A monthly wind speed derived from data collected by Atmospheric Environmental Services (AES).
2. Weibull shape (K) and Scale (A) parameters estimated from previous data reductions.

The resulting histograms would represent estimated data based on characteristics found in prior data reductions which, when summed, should closely resemble the actual data recorded for the total period.

APPENDIX "A"

**Example of the Technical Summary Format for a
Typical VAWT Site**

PERFORMANCE SUMMARY FOR VAWT FIELD TRIAL CHRISTOPHER POINT (MIDDLE)

YEAR: 1986																			CUT IN WIND SPEED 6.6 m/s CUT OUT WIND SPEED 17.9 m/s				(19)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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APPROX. MONTH OF RECORD	TOTAL TIME IN PERIOD	AVERAGE WIND SPEED	K	AVAIL. WIND ENERGY BETZ LIMIT	EST. GEN. TIME	EST. OUTPUT ENERGY	DOWN TIME	STOP TIME	IDLE TIME	ACTUAL GEN. TIME	ACTUAL INPUT ENERGY	ACTUAL OUTPUT ENERGY	ESTIMATED OUTPUT ENERGY FROM GENERATE ONLY HISTOGRAM DATA	ACTUAL OUTPUT ENERGY % OF AVAIL. WIND ENERGY	ACTUAL OUTPUT ENERGY (NO DOWN TIME)	ACTUAL GEN. TIME % OF EST. GEN. TIME	DOWN TIME % OF TOTAL TIME IN PERIOD	ESTIMATED OUTPUT ENERGY FROM GENERATE ONLY HISTOGRAM DATA	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%	%

NOTES: Explanation on following page.

NOTES ON CHRISTOPHER POINT 1986

*1 Data recording period November 25, 1986 to January 4, 1987.

MONTHLY AVERAGE WIND SPEED
AND WEIBULL PARAMETER "K"
AS CALCULATED FROM CONTINUOUSLY
RUNNING WIND HISTOGRAM RECORDER

SITE NAME: CHRISTOPHER POINT (MIDDLE)

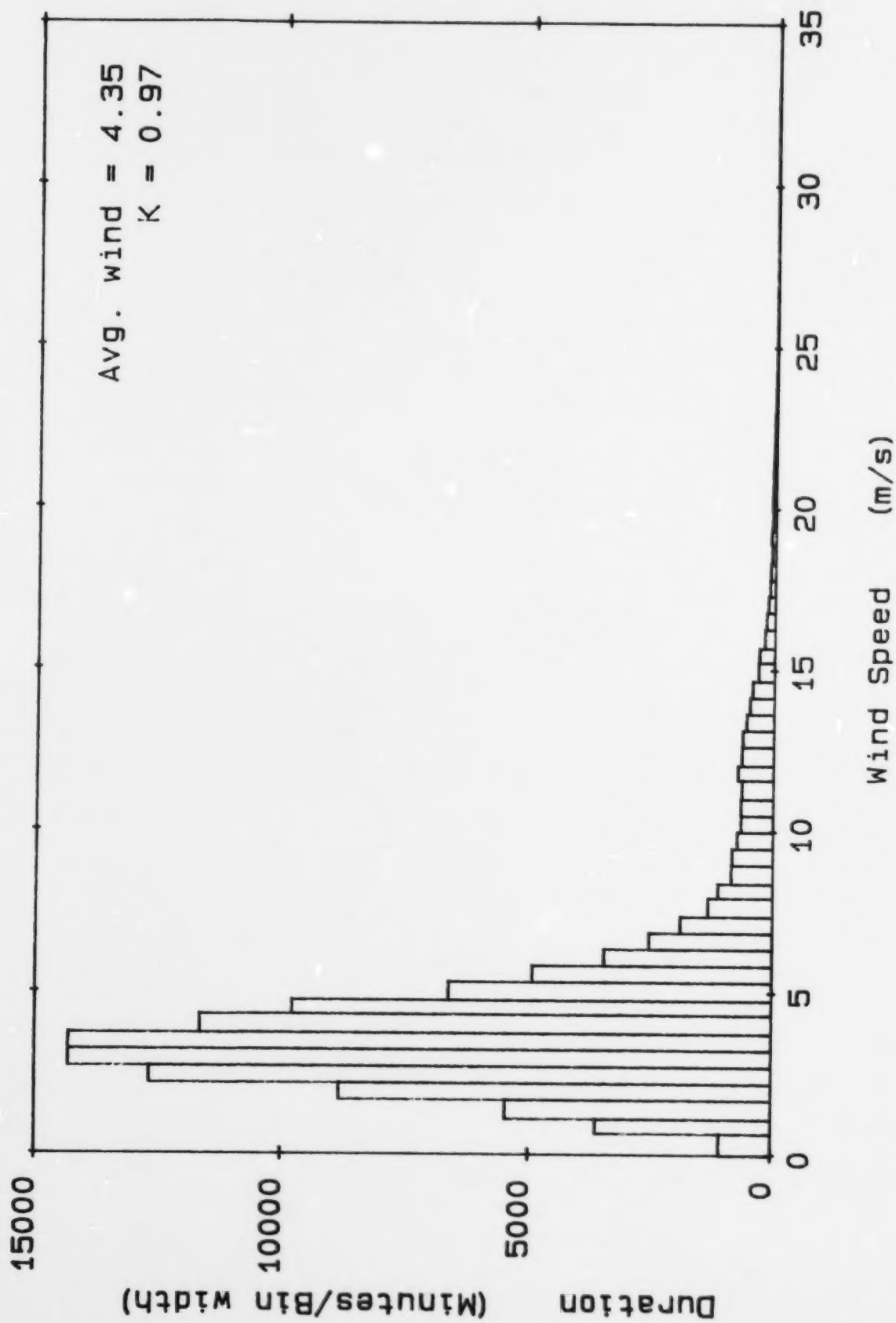
YEAR: 1986

APPROXIMATE MONTH OF RECORD	TOTAL TIME IN PERIOD HOURS	AVERAGE WIND SPEED M/S	WEIBULL PARAMETER "K"	WEIBULL PARAMETER "A"
January	839.1	5.2	0.95	0.253
February	671.6	4.5	1.01	0.268
March	653.3	4.3	1.41	0.121
April	722.3	6.0	1.59	0.051
May	977.6	6.1	1.80	0.032
June	580.0	5.9	1.82	0.033
July	933.3	7.6	2.54	0.005
August	642.3	6.2	2.09	0.018
September	696.2	5.3	1.76	0.044
October	647.7	3.4	1.83	0.077
November	696.6	4.7	1.22	0.155
December*1	981.7	4.3	0.97	0.309
YEAR	9,041.7	5.4	1.44	0.084

Notes: *1 Data reported for period November 25, 1986 to
January 4, 1987.

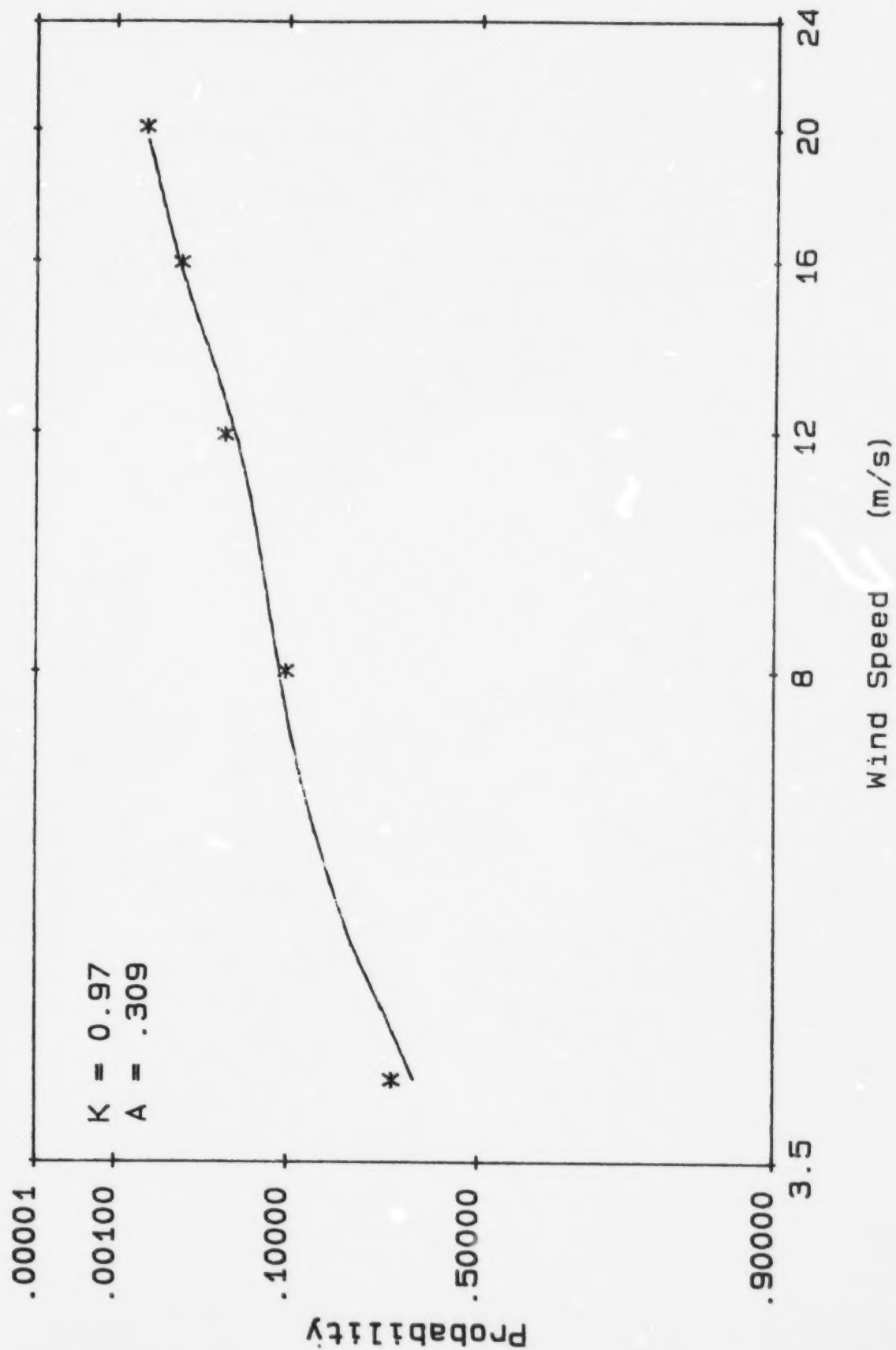
CHRISTOPHER POINT (MIDDLE)

November 25 1986 to January 4 1987



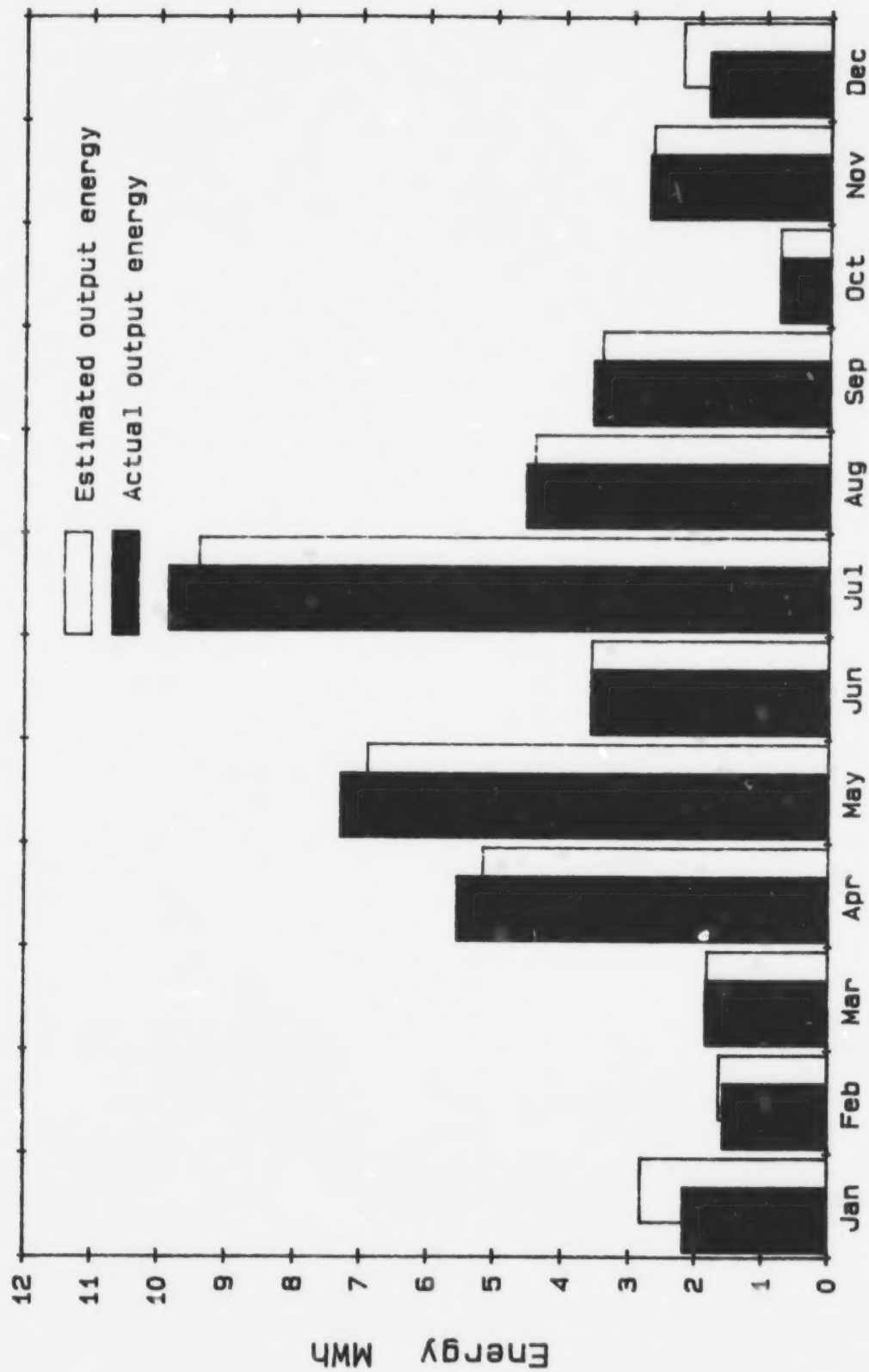
CHRISTOPHER POINT (MIDDLE)

November 25 1986 to January 4 1987



50 kW VAWT OUTPUT 1986

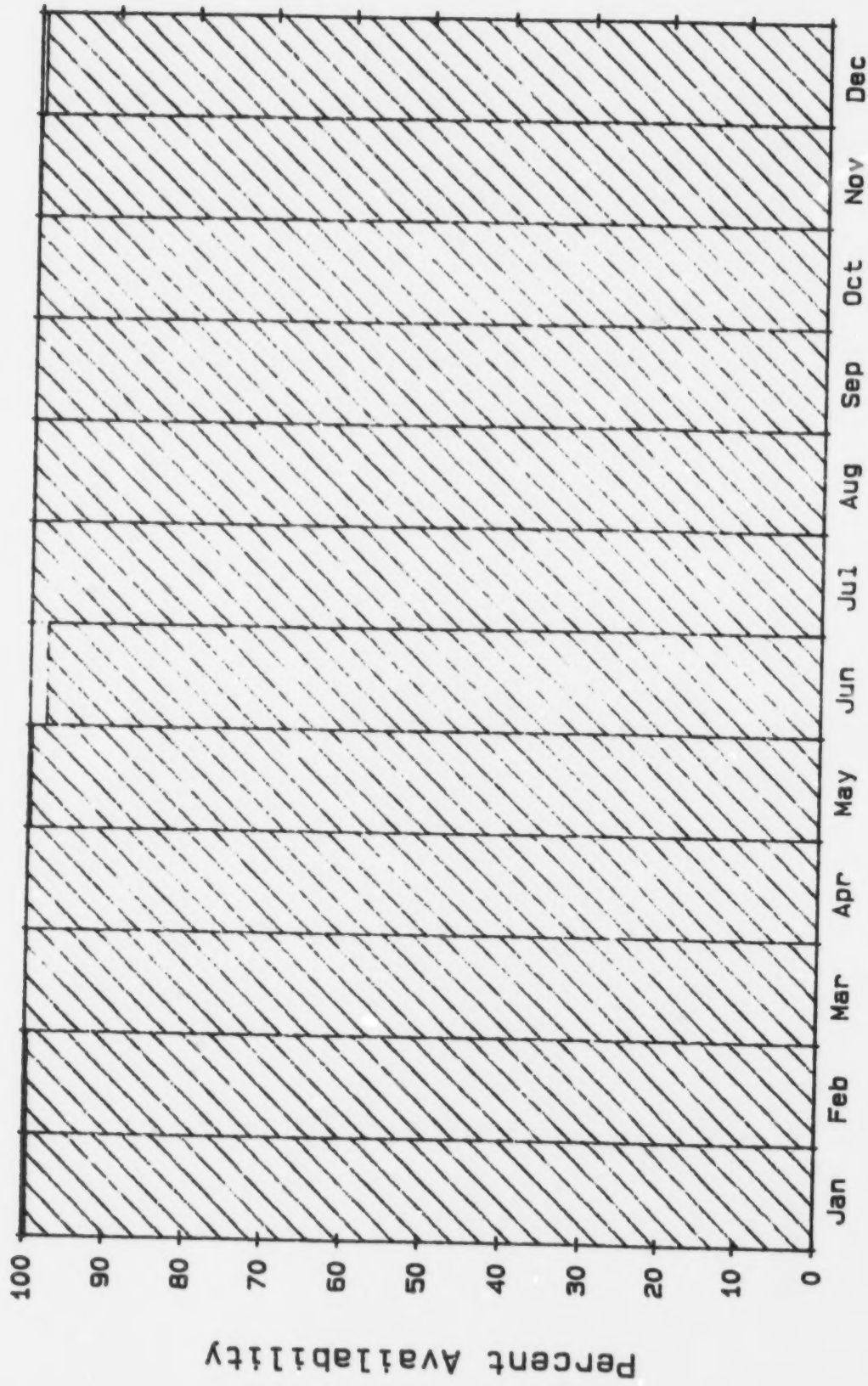
CHRISTOPHER POINT



Month of year 1986

50 kW VAWT AVAILABILITY 1986

CHRISTOPHER POINT



VAWT SYSTEM NOTES: CHRISTOPHER POINT

- Jan, 1981 One of the guy tension cards found to have been damaged and not replaced immediately. Middle Wind Histogram Recorder (WHR) not operating.
- Feb, 1981 Oil leak noticed and cause not apparent. Cut-in raised from 10 to 14 mph (4.47 to 6.26 m/s) and cut-out raised from 30 to 35 mph (13.41 to 15.56 m/s). Generate only WHR found to be inoperative near end of month.
- Mar, 1981 During the month a phase/voltage trip occurred. It was suspected that this resulted from a power failure on the main power grid. The VAWT was shut down during maintenance to the grid. The generate-only WHR was repaired by replacing two printed circuit cards.
- Apr, 1981 VAWT down for repairs of new PT's, wiring, change of capacitors, etc. Trailer meters not functioning properly.
- May, 1981 It was found that two of the trip indicators on the trip indicator board were not connected. The tension meter was found to be inoperative and it was suggested that both this meter and a faulty thermal relay be replaced. Oil leaks were found near the brake shoes, but this was not considered a serious problem. The generate-only WHR which had been repaired recently, failed again.

June, 1981 The tension meter was still reading incorrectly and a fuse on the pump motor had blown. This fuse was replaced, however, the cause for the failure was not found. As a result of an oil leak an oily scale had built up on the shoes, but was considered not serious. Guy tension card tripped and needed replacement. This month's down-time is due to waiting for parts.

July, 1981 The lubrication oil was changed this month. The leak still persisted. Turbine shut down on 25-26 July 1981 to investigate oil disappearance.

Aug, 1981 The guy tension meter was still not operating correctly. The circuit cards for the guy tension were replaced, however this did not make any difference. It was suspected that the meter itself was sticking. The operator found that the control anemometer was shielded at times depending upon the direction of the wind. He was instructed to move the anemometer to a location which was not shielded by the control station.

Sep, 1981 The operating of the 3 position ammeter switch caused the VAWT to shut down for no reason. After further investigation it was found that the turbine would not shut down when the three position ammeter phase switches were changed provided the turbine was not producing power. Indicates electrical interference between switch and turbine controller. Oil was added to make up for the loss due to the leak.

Oct, 1981 Guy tension display still not operating correctly.

Nov, 1981 Oil leaks are still apparent. The guy tension problem was not resolved. Site visit schedule changed from weekly or less to 2 week intervals.

Dec, 1981 On December 10, 1981, during a regular site visit, B.C. Hydro staff observed one of the spoilers was deployed. It would not latch due to a broken locating dowel on the latch plate. The dowel was replaced and the mounting holes in the spoiler welded. Several days later the spoiler was again observed deployed, with one hinge pin missing. The turbine was shut down from 10 to 27 December, 1981 pending repairs.

Jan, 1982 A replacement hinge pin was received from DAF Indal and installed on the damaged spoiler. However, because the spoiler had been hanging from one hinge, the hinges were no longer aligned and binding resulted. Efforts to straighten the hinge failed. It was decided to put the turbine back into service, recognizing that the spoiler would have to be manually latched should it deploy.

Jan, 1982 Modification to the gear lubrication system to prevent oil fogging inside the power module was made as per DAF Indal instructions. During a regular site visit to read the WHR the display on the continuously running lower recorder was found to be off. This was found to be due to a low battery. A subsequent check later in the month found the WHR to be operating correctly and the battery voltage had returned to normal.

Feb, 1982 Early in the month spoilers were removed, fairings were installed on the blades, and a centrifugal overspeed hydraulic dump valve was installed to back up the existing electrically operated valve.

Apr, 1982 On April 23, 1982 the turbine was shut down at NRC's request, so that the rotor couplings could be checked for cracks. No problems were found. During subsequent testing, noises were heard coming from the upper bearing. It was decided to simply grease this bearing. Found 21 trips on max. wind speed shut down and 1 trip on phase volt shut down.

May, 1982 The turbine was down during some of May, 1982 to check cracks on the rotor shaft. The cut-out wind speed was increased from 35 mph to 40 mph (15.65 to 17.88 m/s) on 25 May, 1982.

Jun, 1982 The turbine was found to be inoperative and would not restart even after the hydraulic dump valve had been reset. The problem was traced to the high/low voltage relay. A new relay was requested from NRC. Three Climet anemometers were installed as part of the annual bearing replacement schedule.

July, 1982 It was observed that one of the display segments on the generate-only recorder had burnt out. This resulted in erroneous readings.

Aug, 1982 B.C. Hydro staff readjusted the centrifugal switch to trip at 3 lb. pull, the previous setting of 1.5 to 2.0 lb. being too light. One of the guy tensions was found to be reading too high and it was recommended that this should be investigated.

Sep, 1982 The dump valve operation was checked.

Oct, 1982 Guy tension display problems are still present. The turnbuckles on the guys were changed based on information from VAWT in Eastern Canada. This resulted in the bull gear lift increasing by 1/16 in. VAWT unit put back in service on 29 October, 1982 after clearing up guy problem by changing bottom clevis on North and West Guy. Unit shut down 12 October, waiting for parts.

Nov, 1982 The turbine was shutdown for approximately two days starting 8 November, 1982 while the hydro lines were checked.

Dec, 1982 Squeaking noises heard near the rotor 16 December, 1982.

Jan, 1983 The upper wind histogram recorder was not operating.

Feb, 1983 Vibration caused solid (brittle) wires in control system to break resulting in shut down of unit. Down time most of month due to waiting for new control package replacement. Waiting time 28 days.

Mar, 1983 New controls installed 4 March. Coupling crack running about 160° around found early February. New coupling installed 3 March. Waiting time 7 days. Declared operational 10 March, 1983. Did not reach start up speed in time and therefore tripped. B.C. Hydro line crew inspected power lines for corrosion and made many changes to connectors. Work did not make any change to low voltage condition. Control middle anemometer bearing seized.

Apr, 1983 The control anemometer was moved to a better location on 11-13 April as it was previously in the wake of the turbine. New control timing cards were added to the trip indicator panel. Max. start time for motor to reach 700 rpm raised from 35 sec. to 40 sec. on 11 April 1984. Wrong anemometer was installed (6 volt instead of 12 volt). Unit operational on 14 April 1983.

May, 1983	The available time meter was removed for repair.
Aug, 1983	Trip due to motor not reaching 700 rpm in time.
Oct, 1983	Reports indicated that the turbine volt meter was not operating correctly.
Nov, 1983	B.C. Hydro problems at Jordan River prevented VAWT maintenance and monitoring. No data reported for November, December 1983 and January 1984 because of strike at B.C. Hydro.
Feb, 1984	Maintenance was performed 13-15 February, 1984. Modifications were made to the elapsed time meters to include idle time, and available time. The hydraulic and lubrication oils were changed. Bolts on the rotor were tightened.
May, 1984	The anemometers were changed as part of the annual bearing replacement, however the cups were damaged during the replacement. The problem with the upper anemometer was further investigated and traced to poor wiring between it and the recorder. A new auto control system (card NC 112) was installed. Y-Delta shift changed from 1240 to 1208 rpm on 10 May, 1984 to alleviate possible weak point of the high speed shaft which may have resonance at 60 Hz and xxxxx to delta shift to be quite aggressive.
Jul, 1984	Upper anemometer and lower WHR unserviceable. Lower anemometer and upper WHR rewired together to provide operating system and obtain data.
Oct, 1984	On 19 October, 1984 the unit tripped from a shaft overspeed, and when reset a fire broke out in the generator.
Nov, 1984	The turbine did not operate this month awaiting repairs to the generator. It was assumed that the fire of October, 1984 had resulted from grease on the windings on the motor, which ignited when the overspeed trip occurred.

Jan, 1985 Turbine motor/generator was rewound and replaced on January 21, 1985. DAF Indal visited the site to perform maintenance and install motor. All systems were checked and found to be operating correctly. Motor torque low to reach 700 rpm within 40 secs. in low wind conditions. Found not wound properly.

Mar, 1985 The turbine repairs were completed and limited tests were performed to check the control system. A new motor modified at factory, from 440 V to 575 V was installed and found to be satisfactory. DAF Indal were on the site from March 27, 1985 to April 1, 1985. The turbine was left in automatic mode on March 31, 1985. Rewound motor removed and sent to shops for second rewind.

Apr, 1985 The burnt out motor which had been rewound once was rewound a second time but not installed because locked rotor torque did not reach manufacturer's specification of 453 ft lbs and new motor/generator in place was operating well.

Sep, 1985 The power grid transformer voltage tap was adjusted in error to 580 V a.c. instead of 690 V. Error not discovered as voltage was not measured by line crew.

The 6 month preventative maintenance tasking was completed on the VAWT system. Observations of changes in system performance indicated no improvement due to transformer tap change. The transformer voltage tap was subsequently changed in the other direction by B.C. Hydro line crew to supply 628 V ac to the VAWT motor. Performance observations indicated that under no wind conditions, the motor would now take only 32 seconds to accelerate rotor to 700 rpm. The "run-up time" timer card for the system is to be left unchanged.

New cup set and replacement/spare anemometers sent to site by T E S Limited.

Jan, 1986 VAWT functioning without incident.

Dec, 1986 VAWT system overhaul performed.

APPENDIX "B"

**Typical Monthly Data Reduction Output for a
Prospecting Site**

Site: Université Sainte-Anne
Pointe de l'église N.E., Bow Mo

TIME 4:27 P.M.
 LOGGED DATE Feb. 1st 1987
 BY Nabil Abboud

SET SELECTOR SWITCH TO "COUNT" AND DISPLAY POWER SWITCH TO "ON"

BIN	COUNT					
00	0	0	1	4	8	1
01	0	0	1	4	0	3
02	0	0	5	6	0	9
03	0	2	4	3	6	0
04	0	4	0	7	1	0
05	0	5	4	3	2	3
06	0	6	6	4	3	3
07	0	7	2	1	8	2
08	0	7	8	4	7	2
09	0	5	9	8	8	8
10	0	6	9	0	5	8
11	0	6	4	2	1	8
12	0	6	3	0	4	2
13	0	6	2	0	7	9
14	0	6	1	3	4	9
15	0	6	2	8	6	8
16	0	5	1	8	5	8
17	0	5	4	5	6	4
18	0	4	7	2	9	8
19	0	4	2	2	9	4
20	0	3	8	0	9	3
21	0	3	4	9	1	7
22	0	3	3	3	1	0
23	0	2	7	8	8	7
24	0	2	9	0	3	7
25	0	2	6	0	0	9
26	0	2	3	7	1	7
27	0	2	2	1	3	2
28	0	2	0	7	5	7
29	0	1	9	0	8	3
30	0	1	5	4	9	6
31	0	1	4	0	8	2

COMMENTS: started on Thursday Jan 1st 1987 at 4:45 P.M.

337

BIN	COUNT					
32	0	1	1	3	3	5
33	0	0	8	8	3	9
34	0	0	6	8	7	6
35	0	0	5	3	9	2
36	0	0	4	1	6	6
37	0	0	3	0	8	6
38	0	0	2	4	9	7
39	0	0	1	8	7	5
40	0	0	1	4	0	9
41	0	0	1	1	4	6
42	0	0	0	8	7	1
43	0	0	0	6	3	3
44	0	0	0	4	9	6
45	0	0	0	4	1	4
46	0	0	0	3	6	6
47	0	0	0	2	5	6
48	0	0	0	2	1	5
49	0	0	0	1	3	5
50	0	0	0	1	2	5
51	0	0	0	1	2	4
52	0	0	0	1	0	8
53	0	0	0	0	6	1
54	0	0	0	0	5	9
55	0	0	0	0	4	4
56	0	0	0	0	2	7
57	0	0	0	0	2	3
58	0	0	0	0	2	3
59	0	0	0	0	2	2
60	0	0	0	0	1	0
61	0	0	0	0	0	9
62	0	0	0	0	0	6
63	0	0	0	0	1	5

ANALYSED

CHECKED

FOR NRC

UNIVERSITÉ SAINTÉ ANNE

January 2 1987 to February 1 1987

Processed 19-FEB-87 15:18:56

RESET recorder

BOUND2.414 Bin Definitions for Stainless Cup.

CURVE3.414 - Turbine curve for Stainless steel cups

January temperature = -3.2 degrees C

Operational speed range = 6.6 to 15.65 m/s

January

Elapsed time 743.6 hours

Average wind speed 7.4 m/s

K= 1.85

Betz limit 28900 kW hr

Est. generate time 347.1 hr

Est. output energy cut in 6831.0 kW hr

Est. output energy no cut out 8047.4 kW hr

BIN #	MID BIN SPEED	BIN BOUND	ACC. HST.	ACC. FREQ.	CALCUL. FREQ.	TUR. CURVE	EST. OUTPUT	REF. LIMIT	2. OF REF.
0	0	0	1481	.998374	1	0	0	0	0
1	.46	.92	1403	.997846	.994876	0	0	3.66843E-03	0
2	1.12	1.32	5609	.993656	.973746	0	0	.711569	0
3	1.595	1.87	24360	.97546	.950148	0	0	.765482	0
4	2.105	2.34	40710	.945051	.918149	0	0	10.1946	0
5	2.58	2.82	54323	.904474	.883043	0	0	25.047	0
6	3.055	3.29	66433	.854851	.843601	0	0	50.8546	0
7	3.53	3.77	72182	.800933	.800896	0	0	85.7443	0
8	4.04	4.31	78472	.742318	.752078	0	0	138.922	0
9	4.515	4.72	59888	.697583	.70476	0	0	147.988	0
10	4.99	5.26	69058	.645999	.656422	0	0	230.471	0
11	5.5	5.74	64218	.598031	.604172	0	0	286.852	0
12	5.975	6.21	63042	.550941	.555848	0	0	361.041	0
13	6.45	6.69	62079	.50457	.508423	0	0	447.236	0
14	6.93	7.17	61349	.458744	.4619	3.39	81.4578	548.176	14.85
15	7.44	7.71	62868	.411784	.41448	5.23	182.666	695.122	26.27
16	7.915	8.12	51858	.373048	.372522	8.171	235.407	690.369	34.09
17	8.39	8.66	54564	.332291	.33295	11.16	338.297	865.176	39.10
18	8.895	9.13	47598	.296961	.293693	14.38	377.858	893.703	42.78
19	9.37	9.61	42294	.265369	.259532	17.29	406.257	934.136	43.46
20	9.85	10.09	38093	.236915	.227785	20.08	424.949	977.387	43.47
21	10.325	10.56	34977	.210788	.199112	22.767	442.401	1033.63	42.80
22	10.83	11.1	33310	.185907	.171564	25.47	471.336	1135.98	41.49
23	11.305	11.51	27087	.165076	.148325	28.01	433.953	1001.75	40.11

24	11.785	12.06	29037	.143387	.127353	30.36	489.757	1276.01	36.30
25	12.295	12.53	26009	.127959	.107675	32.68	472.208	1297.84	36.38
26	12.77	13.01	23717	.106243	.0915961	34.63	456.552	1326	34.43
27	13.245	13.48	22132	.0097112	.0775149	36.65	450.632	1380.67	32.63
28	13.72	13.96	20757	.0074204	.0652612	38.41	442.931	1439.26	30.77
29	14.23	14.5	19083	.059521	.0539434	40.23	428.505	1476.3	28.89
30	14.705	14.91	15496	.0483771	.0493368	41.8	359.852	1322.9	27.20
31	15.18	15.45	14082	.0378584	.0372445	43.201	337.976	1322.49	25.55
32	15.69	15.93	11335	.0293916	.0302741	43.201	0	1175.45	0
33	16.165	16.4	8839	.0227891	.024831	43.201	0	1002.4	0
34	16.64	16.88	6876	.017653	.0202649	43.201	0	850.567	0
35	17.115	17.35	5392	.0136254	.0164563	43.201	0	725.76	0
36	17.625	17.9	4166	.0105135	.0130876	43.201	0	612.377	0
37	18.1	18.3	3086	8.20839E-03	.0105194	43.201	0	491.297	0
38	18.575	18.85	2497	6.34322E-03	8.41366E-03	43.201	0	429.653	0
39	19.085	19.32	1875	4.94266E-03	6.58362E-03	43.201	0	349.937	0
40	19.56	19.8	1409	3.87019E-03	5.21244E-03	43.201	0	283.094	0
41	20.035	20.27	1146	3.03417E-03	4.10714E-03	43.201	0	247.437	0
42	20.505	20.74	871	2.38356E-03	3.22881E-03	43.201	0	201.609	0
43	21.015	21.29	633	1.91073E-03	2.47361E-03	43.201	0	157.726	0
44	21.495	21.7	496	1.54024E-03	1.91526E-03	43.201	0	132.253	0
45	21.97	22.24	414	1.23100E-03	1.47976E-03	43.201	0	117.87	0
46	22.48	22.72	366	9.57508E-04	1.11580E-03	43.201	0	111.63	0
47	22.955	23.19	256	7.66385E-04	8.53604E-04	43.201	0	83.1351	0
48	23.43	23.67	215	6.05788E-04	6.49930E-04	43.201	0	74.2451	0
49	23.91	24.15	155	4.90009E-04	4.91069E-04	43.201	0	56.8831	0
50	24.42	24.69	125	3.96638E-04	3.62680E-04	43.201	0	48.8719	0
51	24.895	25.1	124	3.04014E-04	2.72158E-04	43.201	0	51.3654	0
52	25.37	25.64	108	2.23342E-04	2.03274E-04	43.201	0	47.3476	0
53	25.875	26.11	61	1.77778E-04	1.48290E-04	43.201	0	28.3716	0
54	26.35	26.59	59	1.33707E-04	1.09697E-04	43.201	0	28.9805	0
55	26.83	27.07	44	1.00840E-04	8.05096E-05	43.201	0	22.8154	0
56	27.305	27.54	27	8.04722E-05	5.90037E-05	43.201	0	14.7572	0
57	27.81	28.08	23	6.34920E-05	4.21880E-05	43.201	0	13.2014	0
58	28.285	28.49	23	4.63111E-05	3.06258E-05	43.201	0	13.9736	0
59	28.765	29.04	22	2.98784E-05	2.20543E-05	43.201	0	14.0582	0
60	29.275	29.51	10	2.24089E-05	1.54795E-05	43.201	0	6.73602	0
61	29.75	29.99	9	1.56863E-05	1.10795E-05	43.201	0	6.36233	0
62	30.225	30.46	6	1.12045E-05	7.87402E-06	43.201	0	4.44798	0
63	30.7	30.94	15	0	5.59890E-06	43.201	0	11.6525	0

EST ENERGY (KW HR) 8047.42
 BETZ LIMIT (KW HR) 28899.9
 ENERGY % OF BETZ(X) 27.0459
 AVERAGE POWER (KW) 10.82
 AVERAGE BETZ (KW) 38.8569

COUNT = 1338750
 ACTUAL ELAPSED TIME HOURS= 743.751
 A = .0215776 DAYS = 30.9896
 CORR. = .99887

UNIVERSITE SAINTE ANNE

January 2 1987 to February 1 1987

AIR DENSITY COMPENSATION FACTORS
 BASED ON
 A.E.S. NORMALS AT THE CLOSEST A.E.S. STATION

SITE: St. Anne University

ALTITUDE: 17 M

CLOSEST A.E.S. STATION: Weymouth (Falls) N.S.

STD AIR PRESSURE: 101.13 kPa

	AVERAGE MONTHLY A.E.S. TEMPERATURE $T_{avg}^{\circ K}$	COMPENSATION FACTOR f_{comp} $f_{comp} = \frac{288.15}{T_{avg}} \times \frac{\text{Std Air Pressure}}{101.33}$
JANUARY	269.8	1.07
FEBRUARY	269.1	1.07
MARCH	273.1	1.05
APRIL	278.0	1.03
MAY	283.5	1.01
JUNE	288.1	1.00
JULY	291.3	0.99
AUGUST	290.7	0.99
SEPTEMBER	287.1	1.00
OCTOBER	282.5	1.02
NOVEMBER	278.1	1.03
DECEMBER	272.1	1.06

Notes: Compensated Energy Output = Estimated Energy Output $\times f_{comp}$

A.E.S. data obtained from Canadian Climate Normals
 Temperature 1951 - 1980 UDC: 551.582(71)

PERFORMANCE SUMMARY FOR VAWT FIELD TRIAL

UNIVERSITE SAINTE ANNE

CUT IN WIND SPEED 6.6 m/s
CUT OUT WIND SPEED 15.65 m/s

OUT IN WIND SPEED 6.6 m/s CUT OUT WIND SPEED 15.65 m/s																			
YEAR: 1987		ESTIMATED PERFORMANCE (NO DOWN TIME)						ACTUAL PERFORMANCE											19
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
APPROX. MONTH OF RECORD	TOTAL TIME IN PERIOD	AVERAGE WIND SPEED	K	AVAIL. WIND ENERGY BETZ LIMIT	EST. GEN. TIME	EST. OUTPUT ENERGY (comp. value)	DOWN TIME	STOP TIME	IDLE TIME	ACTUAL GEN. TIME	ACTUAL INPUT ENERGY	ACTUAL OUTPUT ENERGY	ESTIMATED OUTPUT ENERGY FROM GENERATE ONLY HISTOGRAM DATA	ACTUAL OUTPUT ENERGY % OF AVAIL. WIND ENERGY	ACTUAL OUTPUT ENERGY % OF EST. OUTPUT ENERGY (NO DOWN TIME)	ACTUAL GEN. TIME % OF EST. GEN. TIME	DOWN TIME % OF TOTAL TIME IN PERIOD	ESTIMATED OUTPUT ENERGY NO DOWN TIME NO CUT OUT WIND SPEED (air density compensated value)	
JAN.	743.8	7.4	1.85	28900	347.1	7309.2							kWh	%	%	%	%	8610.7	
FEB.																			
MAR.																			
APR.																			
MAY																			
JUNE																			
JULY																			
AUG.																			
SEP.																			
OCT.																			
NOV.																			
DEC.																			
SUM.																			

NOTES: Evaluation on following page.

MONTHLY AVERAGE WIND SPEED
AND WEIBULL PARAMETER "K"
AS CALCULATED FROM CONTINUOUSLY
RUNNING WIND HISTOGRAM RECORDER

SITE NAME: UNIVERSITE SAINTE ANNE

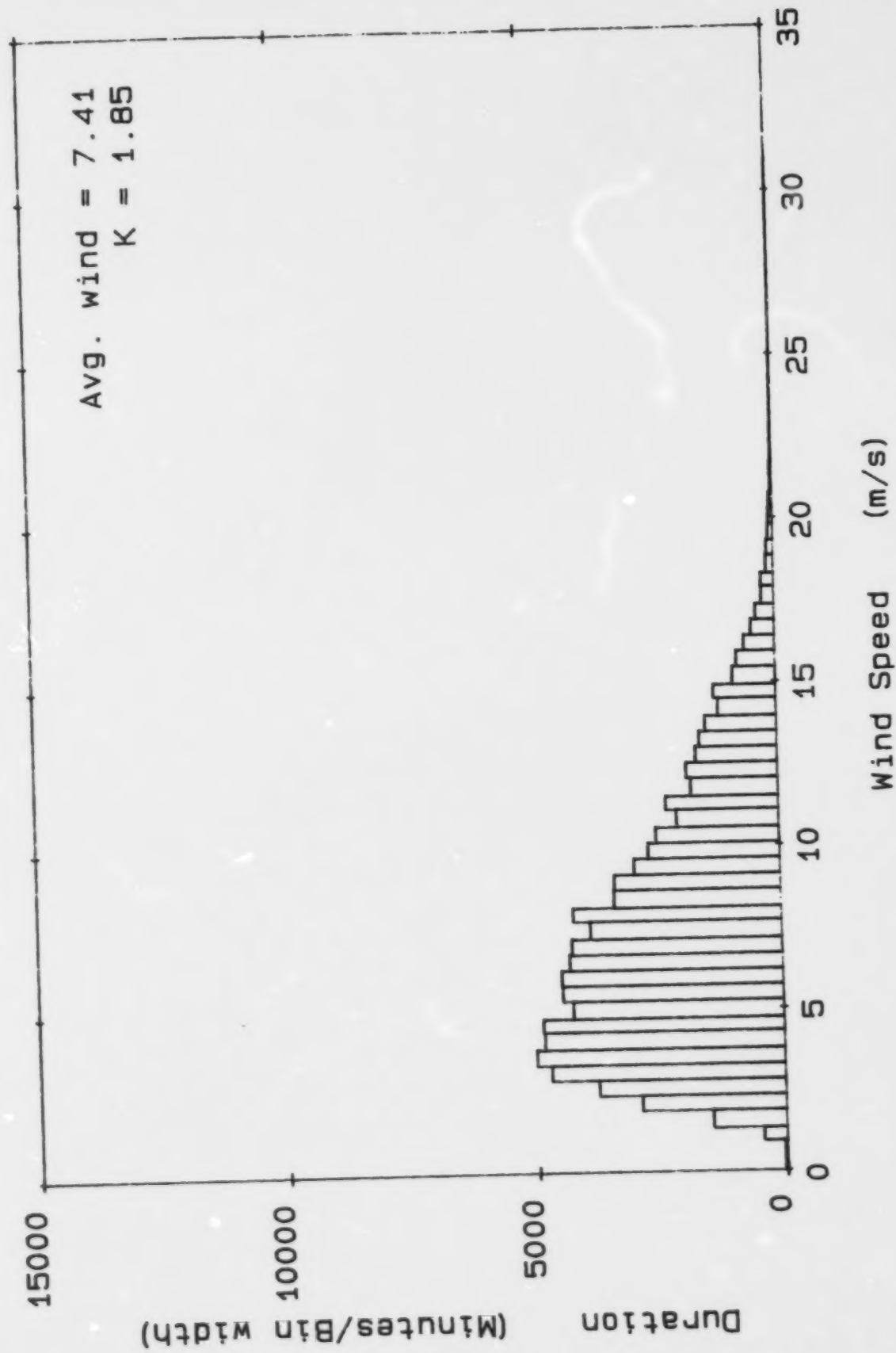
YEAR: 1987

APPROXIMATE MONTH OF RECORD	TOTAL TIME IN PERIOD HOURS	AVERAGE WIND SPEED M/S	WEIBULL PARAMETER "K"	WEIBULL PARAMETER "A"
January February March April May June July August September October November December	743.8	7.4	1.85	0.022
YEAR				

Notes:

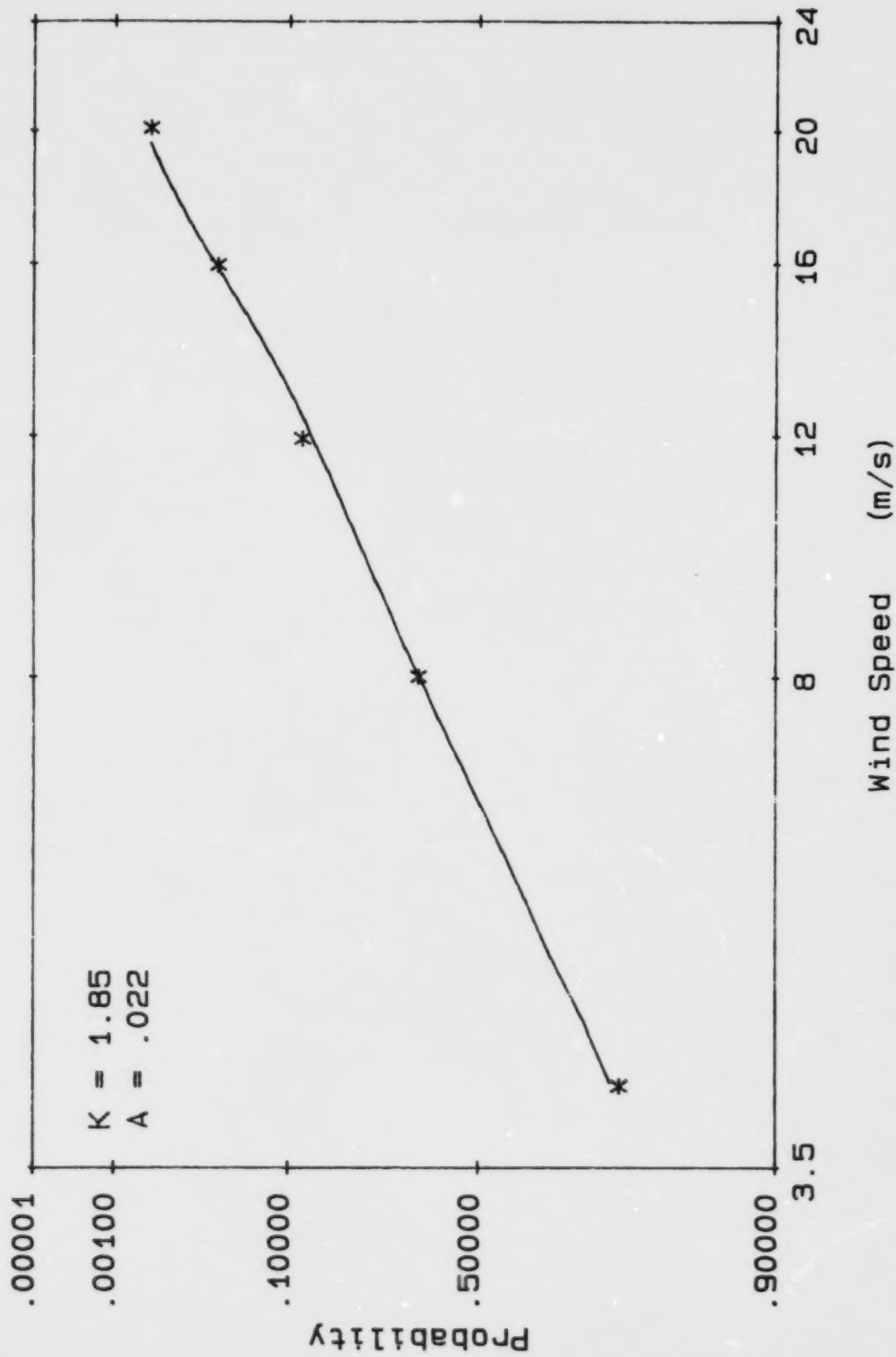
UNIVERSITE SAINTE ANNE

January 2 1987 to February 1 1987



UNIVERSITE SAINTE ANNE

January 2 1987 to February 1 1987



Site Log: Universite Sainte Anne

- Jun. 1986 The site is now operational. It has been erected on the west coast of Nova Scotia at Pointe d'Eglise within ten miles of the Weymouth Falls AES station.
- Aug. 1986 Data is now being reported after some difficulties and the replacement of the anemometer, cable and WHR.

APPENDIX "C"

VAWT Output Summary Sheet

WIND ENERGY R&D PROGRAM

50 kW VAWT FIELD TRIAL SYSTEMS

CUMULATIVE SUMMARY

Period Ending December 31, 1986

LOCATION	PARTNER	START OF GEN. SERVICE	OPERATING HOURS		NET OUTPUT kWh	MEAN WIND SPEED TO DATE	CURRENT STATUS
			IDLING	GEN.			
HOLYROOD, NFLD (I)	NL HYDRO	JUNE 78	NIL 1567	NIL 3015	NIL 21,600	NIL 5.67	Removed for study NOV 81
HOLYROOD, NFLD (II)	NL HYDRO	MAY 82	- 1998.4 0	- 8808.0 507.1	- 99933.0 5260	- 5.74 7.9	Deactivated Feb. 1986 Operational
SWIFT CURRENT, SASK	SASK POWER	AUG 80	144.3 0	12358.1 78.8	111451.8 1855.2	6.51 4.3	Operational
CHRISTOPHER POINT, BC	BC HYDRO	MAR 81	2282.6	13044.6	214462.8	6.27	Operational
CHURCHILL, MAN	CHURCHILL RESEARCH CENTER	NOV 81	NOT AVAIL. 2923.6	308.5 15112.8	4615 190112.0	7.3 6.53	Operational
Legend		TOTALS		Mean Wind Speed Units = Meters/Second			
a		a- Current Month		11730.2			
b		b- Cumulative or average to date		637559.6			

APPENDIX "D"

Instrumentation Installed at Sites

INSTRUMENTATION INSTALLED AT SITES

31-Jan-87

Page 1/2

Site Location/Name	WHR	Anemometer	Cup Sets
BRITISH COLUMBIA			
Vancouver Island (NRC VAWT)			
Christopher Point	1B	448	105R
	1C	654	95R
	1H		368R
Kamloops (Agriculture and Food)			
Rattlesnake Hill	210	321	369
Vancouver (EMR)	223	269	367R
		590	
SASKATCHEWAN			
Swift Current (Ag.Can.)	1G	565	231P (damaged)
	1N	586	229P
		437	235P
			154P
			236P
			77-381
			76-236 (damaged)
			76-217 (damaged)
MANITOBA			
Churchill	1J	661	106R
	213	170,414	207P
	215	530	208P
			244P
			216P

INSTRUMENTATION INSTALLED AT SITES

31-Jan-87

Page 2/2

Site Location/Name	WHR	Anemometer	Cup Sets
NORTHWEST TERRITORIES			
Rankin Inlet	219 224	690,469	211P
Cambridge Bay	1P	489,551	227P
NOVA SCOTIA			
Universite St. Anne	218	552	104R
NEWFOUNDLAND			
Holyrood (VAWT) Removed from Study	204 207	434,483 438	220P
St. Anthony (Nfld & Lab Hydro)	209	409	103R
Miscellaneous Instrumentation			
B.C. HYDRO	216 1K		219P 215P
B.C. HYDRO (Masset)			283 (damaged)
B.C. HYDRO (Surrey BC)	205	517 483 691	226P
AES/Atlantic Wind Test Site		603,666	
Sudbury		539	276P
Kitkatla, B.C. (Removed from Study)	211	671	91R

APPENDIX "E"
Instrumentation Inventory

INSTRUMENTATION INVENTORY

31-Jan-87

All Items Stored in Vault

Page 1/3

Instrument Type	Quantity In Stock	Minimum Quantity	Serial Numbers
1. ANEMOMETER (6V)	31	5	617* 524* 678* 417* 582* 348* 484* 418* 408* 559* 665* 682* 487* 589* 490* 570* 470* 450* 521* 464* 272* 429 537* 461* 475* 416* 654* 496* 482* 504*(DAMAGED)
2. ANEMOMETER (12V)	0	1	
3. ANEMOMETER CABLE	16	5	N/A
4. ANEMOMETER SHIPPING CASE	6	2	A3,A6,A10,A13 2 (NO SERIAL)
5. ANEMOMETER STORAGE TUBE	18	0	N/A

* Indicates equipment received, but not serviced.

INSTRUMENTATION INVENTORY

31-Jan-87

All Items Stored in Vault

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Instrument Type	Quantity In Stock	Minimum Quantity	Serial Numbers
6. WIND HISTOGRAM RECORDER	22	5	225* 1I* 1R* 212* 217 1A* 1M* 214* 1F 202* 1D* 208* 1U* 203 T* 1S* 1E* 1L* 10* 1Q* 206 220*
7. WHR BATTERY	11	20	N/A
7a. Failed WHR Batteries	9		
8. WHR BATTERY CONNECTOR	26	10	N/A
9. WHR SOLAR CELL	19	5	H0216014,0215477,0216021 517228,0215196,0210230 0216011,0215191 0210234,0216028 0515204,0451021 H0215424,0451044 0451020,0451032 0451082,0451060 0451014
10. WHR SHIPPING CASE	0	2	

INSTRUMENTATION INVENTORY

31-Jan-87

All Items Stored in Vault

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Instrument Type	Quantity In Stock	Minimum Quantity	Serial Numbers
11. SERVICEABLE CUP SET	8	10	219P 274P 94R 101R 41R 93R 102R 421
12. UNSERVICEABLE CUP SET (ITEMS NOT SAVED)	52	0	26R 280P 232P 31R 228P 147P 107R 155P 148P 212P 108P 199R 198R 278P 209P 221P 237P 179P 142P 178P 271P 277P 213P 214P 270P 40R 90R 33R 38R 32R 27R 282P 146P 199P 42R 273P 30R 92R 151P 234P 225P 28R 75P 76P 35R 224P 230P 210P 275P 217P 281P 200R 36R 34R 29R
13. UNSERVICEABLE SOLAR PANEL (ITEM NOT SAVED)			0515482

APPENDIX "F"

Tower Inventory

TOWER INVENTORY

31-Jan-87

All Items Stored Above Military Stores Area

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Part Description	Daf-Indal Part Number	Quantity In Stock	Quantity/ Tower
1. TOP TOWER SECTION	N/A	3	1
2. INTERMEDIATE TOWER SECTION	N/A	15	5
3. BOTTOM TOWER SECTION	N/A	5	1
4. PYRAMID BASE	N/A	4	1
5. 10FT. MAST EXTENSION	N/A	1	1
6. 4FT. MAST EXTENSION	N/A	2	1
7. ANEMOMETER COUPLING	N/A	1	1
8. SOLAR CELL MOUNTING PLATE	N/A	7	1
9. DELHI GUY STATION	D-2551-1-6	4	1
10. 3/8" - 16X1" BOLT	N/A	0	39
11. 3/8" - 16 NUT	N/A	0	39
12. 3/8" LOCK WASHER	N/A	0	39
13. 1/4" - 20X1" SCREW	D-2551-1-12	100	6
14. 1/4" - 20 LOCK NUT	D-2551-1-13	100	6
15. 1/4" FLAT WASHER	D-2551-1-15	100	12
16. #6 - 32X1/2" SCREW	D-2551-1-9	100	4
17. #6 - 32 NUT	D-2551-1-10	100	4
18. #6 LOCK WASHER	D-2551-1-11	100	4
19. 5/16" - 18 LOCK NUT	D-2551-1-14	0	3
20. CHAIN SHACKLE	D-2551-1-16	0	3
21. ROPE THIMBLE (3/8")	D-2551-1-17	0	6
22. ROPE CLIPS (3/8")	D-2551-1-18	0	12
23. TURNBUCKLES (3/8")	N/A	0	3

TOWER INVENTORY

31-Jan-87

All Items Stored Above Military Stores Area

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Part Description	Daf-Indal Part Number	Quantity In Stock	Quantity/ Tower
24. MAIN GUY WIRE (3/8"-7) FT.	D-2551-1-19	300	300
25. INTER. GUY WIRE (#9 GA) FT.	D-2551-1-21	300	300
26. CABLE TIES (BOX OF 100)	D-2551-1-20	0	1
27. INSTALLATION DRAWING	D-2551-1	0	1

TOWER INVENTORY

31-Jan-87

All Items Stored Above Military Stores Area

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Part Description	Daf-Indal Part Number	Quantity In Stock	Quantity/ Tower

Unspecified Parts			
28. ROPE THIMBLES (3/16")	N/A	6	6
29. ROPE CLIPS (3/16")	N/A	3	12
30. TURNBUCKLES (1/2")	N/A	5	N/A
31. WIRE GUY (3/16" - 7) FT.	N/A	300	300
32. ROOF BRACKETS	N/A	4	N/A
33. TURNBUCKLES (3/16")	N/A	3	3
34. ROPE THIMBLES (1/4")	N/A	21	N/A
35. ROUND FILE	N/A	0	1

APPENDIX "G"

Instrumentation Spares Inventory

INSTRUMENTATION SPARES INVENTORY

31-Jan-87

ANEMOMETER PARTS LIST - All Items Stored in Electrical Department

Page 1/2

Drwg. No.	Part Name	Climet Part No.	Quantity in Stock	Quantity/ Anemometer	Minimum Quantity
1.	COVER	B8171	2	1	1
2.	TOP HOUSING	B8169	2	1	1
4.	BOTTOM HOUSING	B8170	2	1	1
5.	CIRCUIT CARD ASSEMBLY (6V)	05-A817	2 *	1	3
5A.	CIRCUIT CARD ASSEMBLY (12V)	05-A817	0 *	1	3
6.	WIND SPEED DRIVE EXTENSION	A1006	0 *	1	2
7.	CHOPPER	A8173	2	1	2
8.	"O" RING	63-6029	8	2	2
9.	STANDOFF	A8188	6	3	3
10.	STANDOFF (SQUARE)	A8177	2	2	2
11.	LED PHOTODIODE	43-0009	1 *	1	3
12.	HUB	B8172	1 *	1	2
13.	SET SCREW	60-2613	0 *	2	2
14.	BINDER HEAD SCREW (6/32X9/16)	60-3211	10	6	6
15.	RECEPTACLE	49-2516	2	1	1
16.	SPACER	64-1009	0 *	1	1
17.	SPACER	64-1041	6	1	1
18.	BEARING	06-1035	13 *	02	20
19.	COLUMN	B8187	2	1	1
20.	SLINGER	A1004	7	1	1
21.	SHIELD	A8184	7	1	1
22.	SPACER	64-1120	1	1	1
23.	PROTECTIVE COATING	75-0108-1		N/A	N/A
24.	SHAFT	A8189	6	1	2
25.	SUPPORT ROD	B8186	8	1	2
26.	SILICON RUBBER	75-0104		N/A	N/A
27.	SCREW SOCKET HEAD (8/32X1/4)	60-4612	9	1	2
28.	NYLON WASHER #6	63-1805	11	8	8
29.	BINDER HEAD SCREW (4/40X1/2)	60-2205	12	1	2
30.	BINDER HEAD SCREW (4/40X3/8)	60-2204	12	1	2
31.	BINDER HEAD SCREW (4/40X1/4)	60-2202	12	4	2
32.	DOWEL	64-4001	0 *	1	3
33.	DOWEL	64-4002	0 *	1	1
34.	EPOXY	75-0101		N/A	N/A

Miscellaneous Anemometer Parts

1.	LM2917 (12 VOLT CARD)	9	1	2
2.	LM2907 (6 VOLT CARD)	7	1	2
3.	2N3702 TRANSISTOR	10	1	2
4.	2N3707 TRANSISTOR	10	1	2
5.	RETAINING RINGS	2	1	2
6.	6V ANEMOMETER CARDS (INCOMPLETE)	3	N/A	N/A
7.	12V ANEMOMETER CARDS (INCOMPLETE)	5	N/A	N/A

* Indicates quantity below minimum requirements

INSTRUMENTATION SPARES INVENTORY

31-Jan-87

WHR PARTS LIST - All Items Stored in Electrical Department

Page 2/2

Description	Quantity in Stock	Quantity/ WHR	Minimum Quantity
1. BASES WITH PRINTED CIRCUIT BOARD (PCB)	8	N/A	N/A
2. BASES - COMPLETE	7	1	1
3. READOUT CABLE	1	1	1
4. TERMINAL COVERS	14	1	2
5. SOLAR PANEL (non modified)	1	N/A	N/A
6. DISPLAY P.C.B - COMPLETE	6	1	2
7. FRONT PANEL	1	1	1
8. PCB - #103 - COMPLETE	3	1	2
9. PCB - #103	4	N/A	N/A
10. PCB - #104 - COMPLETE	3	1	2
11. PCB - #104	5	N/A	N/A
12. PCB - #105 - COMPLETE	5	1	2
13. PCB - #105	3	N/A	N/A
14. PCB - #106 - COMPLETE	5	1	2
15. PCB - #106	1	N/A	N/A

APPENDIX "H"

Westinghouse Recorder Software Users Manual



WESTINGHOUSE EWR-84R RECORDER
SOFTWARE USERS MANUAL
IBM-PC

April, 1987

Prepared for
RENEWABLE ENERGY BRANCH
DEPARTMENT OF ENERGY MINES AND RESOURCES

By
T E S Limited
Ottawa, Canada

T E S File Number: C697-A1

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1.0 INTRODUCTION

T E S Limited was contracted by the Renewable Energy Branch of the Department of Energy, Mines, and Resources to provide a software package to communicate with, and extract data from a Westinghouse Model EWR-84R demand recorder.

The software package was designed to acquire data from a remote data logger (the Westinghouse EWR-84R), run on an IBM PC (or compatible) equipped with a 300 Baud Modem and to communicate with the logger over voice telephone lines.

The data are transferred using the Westinghouse communication protocol and the software package will produce an ASCII format data file, with comma delimiters to be compatible with the spreadsheet, Lotus 1-2-3 file requirements. Data files are named automatically with a filename based on the system date.

The software is menu driven and provides direct data logger access to review and modify various operating parameters. The software was written with the expectation that the user will be familiar with the data logger status flags and various parameters indicating the condition of the machine. To this end a condensed version of the Westinghouse Mass Data Acquisition System Communication Protocol Users Guide and the Westinghouse Type EWR-84R Solid State Demand Recorder Operating Instructions Manual was also provided to EMR. Although the software is written such that normal data collection will not require reference to these manuals, in the event that problems should arise with the data logger unit, the manuals should be referenced.

2.0 MINIMUM SYSTEM CONFIGURATION

The software for remote interrogation of the EWR-84R demand recorder was written using the Microsoft BASICA (Version 3.00) high level language with a CRC checksum routine written in 8086 machine language. These two programs were linked and compiled using the Microsoft Quick Basic Compiler (Version 2.0).

The minimum system hardware configuration should consist of an IBM PC (or compatible) computer running the MS-DOS 2.1 (or higher) operating system, with the following peripherals/options:

- Dual 5 1/4 inch floppy disks
- 256 Kbyte memory (RAM)
- RS232 serial port (COM1)
- 300 baud modem with serial RS232 interface
- printer/plotter
- spreadsheet (e.g. Lotus 1-2-3) program.

The system disk in drive A should contain the following copies of the distribution programs and files:

SYSTEM DISK (Drive A)

EWR.EXE - The interrogation software
UPDATE.EWR - Data file for the interrogation program

DATA DISK (Drive B)

Requires no programs or files, it is used exclusively for file storage.
Data received from the demand recorder will be stored on this disk.

3.0 SOFTWARE OVERVIEW

Operation of the software is straightforward, with single keystrokes in a menu driven environment (See Appendix A) typically being all that is required to complete the various functions. The exception being where data input is required from the operator for items such as current date and time, or various programmable constants for reconfiguration of the EWR-84R itself.

3.1 DATA STORAGE

Data gathered from the EWR-84R unit is stored in drive B and is of variable length for each acquisition period. A Raw data File is created named RFddmmyy.EWR (where current computer date is: dd=day mm=month yy=year) for each acquisition.

This file contains the bubble cartridge header, logging start time marker, data, and finally the stop time marker. For a sampling period of 1 month (@ 15min./interval) the file will be about 35 Kbytes in length (this varies depending on the number of local power outages). These raw data files should be archived once created since they provide detailed information about the recorder status and data (refer to Westinghouse Manual Under Header, Marker and Power Outage Records).

From the raw files (RFxxFiles) the Interpreted data File is created (also on Drive B) and is named using a similar date convention of IFddmmyy.EWR. This IFxx file is an ASCII, Lotus 1-2-3 compatible file.

Each record in the file consists of the: interval start time; the pulse count for each channel; and a field indicating whether or not the interval is complete (ie. was there a power outage during the interval?). This file may be loaded directly into the spreadsheet program for further manipulation. These Interpreted data Files (IFxxfiles) need not be kept as they can be created again at any time from the Raw Files (RxxFiles). A typical acquisition period of 1

month will produce an Interpreted data File of about 85 Kbytes in length.

A more detailed explanation of the RFxx.EWR and IFxx.EWR file structures can be found in Appendix B.

3.2 PROGRAM OPERATION

To start the program the disk containing the programs EWR.ExE and UPDATE.EWR should be in Drive A and at the system prompt, the user should enter:

EWR (followed by a carriage return).

The program starts with a system date and time check. These must be updated properly, as all file names and time data are referenced with respect to these. If the battery backup option is included in your system, all that is required is usually a Yes response, (but check to be sure that the battery backup has not failed and the time and date is correct).

From here the program is menu driven and the operation is self-explanatory for the majority of options. A complete source listing of both the BASIC and assembler language codes are found in Appendix C.

3.2.1 MAIN MENU

This menu is the basic program directive selection. You can collect data, gain direct access to the EWR-84R unit itself, or interpret raw files (RF...Files) to produce the spreadsheet files. Simply press the [1][2] or [3] key for the desired function.

3.2.1.1 MAIN MENU FUNCTION [1]: COLLECT DATA

This function allows for either placing a call to the EWR-84R unit now, or setting the time for collection of data at a later time (after hours for lower telephone rates).

3.2.1.2 MAIN MENU FUNCTION [2]: DIRECT ACCESS

This function brings up the second menu for direct access. Again a single keystroke [1-5] will activate the desired function under this menu.

3.2.1.2.1 DIRECT ACCESS MENU FUNCTION [1]: STATUS CHECK

This function displays the current status of the EWR-84R (refer to the Westinghouse Manuals for Clarification).

3.2.1.2.2 DIRECT ACCESS MENU FUNCTION [2]: READ EWR MENU

This function brings up a sub-menu for reading various recorder constants and data. Please refer to the Westinghouse Manuals for clarification of the meaning of the various constants. This menu will allow the user to check the bubble cartridge header, configuration RAM data, read sections of bubble memory, and dump the full contents of bubble memory to disk (using 5 character user file name input). The dump file is named as Fid EWR.DMP where Fid is a 5 character name entered by the user at dump time. The file will be 64 Kbytes in length. See Appendix B for file specification. This file cannot be interpreted by the program, and is intended for use when a problem exists in routine data collection to retrieve data and recover information manually.

3.2.1.2.3 DIRECT ACCESS MENU FUNCTION [3]: RESET TIME

In the case of an EWR-84R clock error, this function will allow resetting of the time in the recorder.

3.2.1.2.4 DIRECT ACCESS MENU FUNCTION [4]: RECONFIGURE

This function will allow the user to enter a 14 BYTE recorder ID, and set the sampling interval. This function will initialize the EWR-84R so the user must collect the data first (Main Menu Option 1) or data in the recorder will be lost.

3.2.1.2.5 DIRECT ACCESS MENU FUNCTION [5]: INITIALIZE

This function is used at installation time to initialize the recorder. The recorder may be initialized at any time, but the user must collect any data first or else data in the recorder will be lost.

3.2.3 MAIN MENU FUNCTION [3]: INTERPRET RAW FILE

This function displays the available raw files (RF...Files) and the available disk space (on the drive B-data disk). The user is prompted to enter the desired file for interpretation. If the raw data file is corrupted this function will halt and produce no output. If the raw data file is OK, then the output will be a Lotus 1-2-3 compatible file named as IFddmmyy.EWR. The user should be sure there is room on the disk for the new file.

4.0 FILE AND RECORDER MANAGEMENT

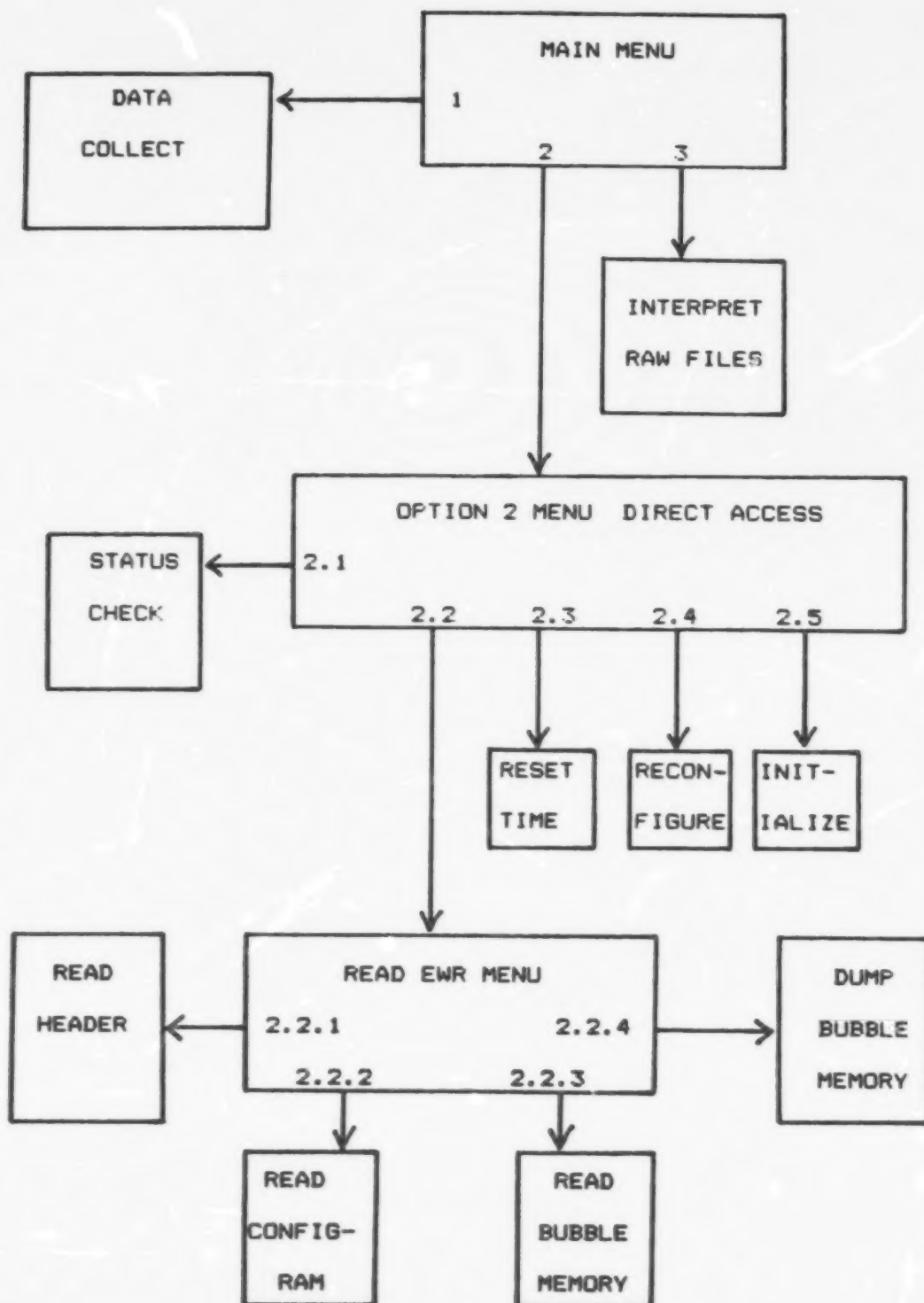
The recorder may be configured for 5, 15, or 30 minute interval timing (with 4 channels operating as a fixed manufacturer's parameter on the EWR-84R units provided). This means that a maximum of 18, 55 or 110 days of data respectively, may be accumulated in the EWR-84R unit before the memory is full. If data is not collected from the recorder before each accumulation limit is reached, new data will be written over top of old data, and data will be lost. Furthermore, the program for locating partial read pointers will not be able to locate data and the data collection routine will report an error. If such a data wrap-around condition should occur (indicated by a "cannot find start marker" message in the data collect function - Main Menu Option [1], the user must dump the full contents of bubble memory to disk and re-initialize the recorder (with Direct Access Options [2.4] and [2.5] respectively.) Any recoverable data must then be picked out manually from the dump file (refer to Westinghouse Manuals for Help).

To avoid this wrap-around condition it is recommended that for sampling intervals of 5, 15 and 30 minutes that data is collected every two weeks, 1 month and 3 months respectively.

With the above mentioned collection times each Raw File (RF...File) and interpreted file (IF...File) will occupy 100-120 Kbytes of disk space so a maximum of three collections per disk are allowed (assuming the standard 360 Kbyte capacity per each 5 1/4" double sided disk). It is not recommended to fill a disk to capacity since it is possible for a collection period to require more than 120 Kbytes, therefore we recommend two collection periods per disk (if both RF... and IF... files are kept). If only RF... files are to be kept (IF... files may be created at any time from RF...files) then 6 collection periods may be kept on a disk, with room on the disk left to create any one (1 only) IF...File as required. This IF...File may be deleted from the disk at the users discretion. Note: be very careful not to delete the RF...Files as they are not recoverable without extensive disk manipulation software which may or may not recover the file.

APPENDIX "A"

Program Menu Configuration



APPENDIX "B"

Data File Structures

DATA FILE: UPDATE. EWR

Sequential ASCII File, Single Record. Length = 15

This is used to store program parameters, the only one which may be user altered is the telephone number of the EWR-84R recorder.

Format is:

Byte

0	LO Byte last word accessed
1	HI Byte last word accessed
2	LO Byte password
3	HI Byte password
4	x
5	x
6	x
7	x Phone number right justified padded with zero's
8	x ie 16137311819
9	x or 00017311820
10	x or 00007311821
11	x
12	x
13	x
14	x

To enter a new phone number enter and run the following BASIC program after editing line 140 to contain the required number:

```
100 Open "I", #2, "Update.EWR"
110 A$ = Input $ (4,2)
120 Close 2
140 Data "13157774162": REM Phone number here (11 digits!) right
      justified padded with zero's

150 Read B$
160 Open "O", #2, "Update.EWR"
170 Print #2, A$ + B$;
180 Close 2
190 END
```

DATA FILE: RFddmmyy.EWR

Sequential ASCII File, Single Record.Length = Variable

This file is the raw data retrieved from the EWR-84R unit and contains the 12-bit words from the recorder in three digit ASCII Hexadecimal format packed with no delimiters.

Format is:

BYTE

0-2 xxx 12 bit word 1 (3 digit hex ASCII)

3-5 xxx 12 bit word 2

6-8 xxx

.

.

.

N-N xxx 12 bit word N

The file is a single record, broken down into 4 main sections as follows:

BYTE

0-149 50,12 bit header words

150-329 60,12 bit start marker words

.

. 12 bit data block words (all data, markers, etc)

.

N-179-N 60,12 bit stop marker words

Refer to the Westinghouse Manual(s) for information on data blocks and information on header and marker blocks.

DATA FILE: IFddmmyy.EWR

Sequential ASCII File, Multiple Records. Length = 35/record

This file is the interpreted spreadsheet Lotus 1-2-3 data file created from the Raw data Files (RF...Files). It may be printed directly to a printer or loaded (imported) into the spreadsheet for manipulation. It uses comma delimiters, with a carriage return at the end of each record. The record format is:

DD MM YY hh mm ss, chA, chB, chC, chDm X cr

where DD = day

MM = month

YY = year

hh = hour

mm = minutes

ss = seconds

cha = Channel A data value at time hhmss

chB = Channel B data value at time hhmss

chC = Channel C data value at time hhmss

chD = Channel D data value at time hhmss

X = Condition code (* - partial interval, (space) - full interval)

Partial intervals are indicated in one of two ways:

- 1) An asterisk in the condition code field indicates a partial interval due to a short power outage
- 2) If the seconds count in a partial interval is not equal to zero, then both that interval, and the preceeding interval are partial intervals due to a long power outage.

Note 1: The first and last records are always partial intervals. There

is no data loss if you add the last interval of the previous collection to this collection's first interval, and you add this collection's last interval to the first interval of the next collection time.

Note 2: Counter overflows are indicated by a count value of 9999 (since maximum count = 4063)

DATA FILE: nnnnnEWR.DMP

Where n = 5 Digit User Supplied Name.

Sequential ASCII File, Single Record.Length = 65535 Bytes

This File is a simple and total dump of the bubble cartridge memory and is a single record with no delimiters. It may be read 3 Bytes at a time and dumped directly to a printer or screen for manual data retrieval in the case of EWR-84R malfunction or memory-wrap around condition (see Section 4.0 File and Recorder Management, also refer to the Westinghouse Manual(s) for assistance) in Picking Out Data.

Data File Format is:

Byte

0	-	2	xxx	12 bit word 1 (3 digit hex ASCII)
3	-	5	xxx	12 bit word 2
6	-	8	xxx	12 bit word 3

.
. .
.

65533-65535 xxx 12 bit word 21845

APPENDIX "C"

Source Code Listing

```

100 COLOR 7,0:WRF$="XXX":DIM REQ$(11)
110 CLS:KEY OFF:PRINT CHR$(201)+STRING$(77,205)+CHR$(187)
120 PRINT CHR$(186)+" EWR - B 4 R  C O N T R O L  A N D  I N T E R R O G A T I O N  TES87.1 "+CHR$(186)
130 PRINT CHR$(200)+STRING$(77,205)+CHR$(188):PRINT:PRINT
140 COLOR 0,7:PRINT " CHECK SYSTEM DATE AND TIME ....":COLOR 7,0:PRINT:PRINT
150 PRINT "IS THE TIME CORRECT ? ";TIME$;" (Y/N) >";
160 ON INSTR(" YN",INKEY$)+1 GOTO 160,160,180,170
170 INPUT " N   ENTER HH:MM:SS ",T$:TIME$=T$:GOTO 190
180 PRINT " Y"
190 PRINT:PRINT:PRINT "IS THE DATE CORRECT ? ";DATE$;" (Y/N) >";
200 ON INSTR(" YN",INKEY$)+1 GOTO 200,200,220,210
210 INPUT " N   ENTER MM-DD-YYYY ",T$:DATE$=T$
220 OPEN "I",#2,"UPDATE.EMR":UP$=INPUT$(4,2):CLOSE 2:PWD$=LEFT$(UP$,2):GOSUB 230:GOTO 1000
230 RESTORE 240:FOR I=1 TO 10:REQ$(I)=CHR$(1):READ A:REQ$(I)=REQ$(I)+CHR$(A)+CHR$(1)+STRING$(5,22)+PWD$:NEXT I:RETURN
240 DATA 17,20,21,22,23,28,33,65,81,82
1000 REM *****
1010 REM MAIN MENU ...
1020 REM *****
1030 VIEW PRINT:CLS:PRINT CHR$(201)+STRING$(77,205)+CHR$(187)
1040 PRINT CHR$(186)+" EWR - B 4 R  C O N T R O L  A N D  I N T E R R O G A T I O N  TES87.1 "+CHR$(186)
1050 PRINT CHR$(186)+STRING$(77,32)+CHR$(186)
1060 PRINT CHR$(186)+"   DATE IS (MM-DD-YYYY): "+DATE$+"   TIME IS (HH:MM:SS): "+TIME$+"   "+CHR$(186)
1070 PRINT CHR$(186)+STRING$(77,196)+CHR$(186):PRINT CHR$(186)+STRING$(77,32)+CHR$(186)
1080 PRINT CHR$(186)+" M A I N  M E N U :  S E L E C T   1 = ROUTINE DATA COLLECTION (RAW FILES) "+CHR$(186)
1090 PRINT CHR$(186)+"                                     2 = ACCESS RECORDER TO ALTER PARAMETERS "+CHR$(186)
1100 PRINT CHR$(186)+"                                     3 = INTERPRET PREVIOUSLY SAVED DATA FILE "+CHR$(186)
1110 PRINT CHR$(186)+"                                     4 = PRINT INTERPRETED FILE "+CHR$(186)
1120 PRINT CHR$(186)+"                                     5 = END PROGRAM "+CHR$(186)
1130 PRINT CHR$(186)+STRING$(77,32)+CHR$(186)
1140 PRINT CHR$(186)+"               PRESS APPROPRIATE KEY TO START FUNCTION... "+CHR$(186)
1150 PRINT CHR$(200)+STRING$(77,205)+CHR$(188)
1160 ON INSTR(" 12345",INKEY$)+1 GOTO 1160,1160,8000,9000,20000,1160,1170
1170 CLS:END:REM END OF PROGRAM
2000 REM *****
2010 REM SEND COMMAND / RECIEVE RESPONSE BLOCKS
2020 REM - REQUIRES C$ WITH COMMAND STRING (10 BYTES)
2030 REM - APPENDS 2 BYTE CHECKSUM (LO-HI BYTE)
2040 REM - OPENS AND CLOSES 'COM1' FILES (#1)
2050 REM - RETURNS RESPONSE BLOCK IN C$ WITH A PREFIX AS FOLLOWS...
2060 REM   CHR$(1) PREFIX = NO RESPONSE FROM RECORDER
2070 REM   CHR$(2) PREFIX = BUFFER OVERFLOW
2080 REM   CHR$(3) PREFIX = NAK BLOCK RETURNED
2090 REM   CHR$(4) PREFIX = COMMAND ACCEPTED, RESPONSE VALID
2100 REM   CHR$(5) PREFIX = CHECKSUM ERROR DETECTED
2110 REM *****
2120 OPEN "COM1:300,N,8,1" AS #1 LEN=400
2130 CALL CRC(C$,SMZ):IF SMZ<0 THEN SQ$=SMZ+65536! ELSE SQ$=SMZ
2140 PRINT #1,C$+CHR$(SQ$-INT(SQ$/256)*256)+CHR$(INT(SQ$/256))
2150 LX=LOC(1):FOR IX=1 TO 8000:IF LOC(1)>LX THEN IX=15000
2160 NEXT IX:IF IX>13000 THEN 2150
2170 IF LOC(1)<6 THEN C$=CHR$(1):CLOSE 1:RETURN
2180 IF LOC(1)>250 THEN C$=CHR$(2):CLOSE 1:RETURN ELSE C$=INPUT$(LOC(1),1)
2190 IF ASC(MID$(C$,4,1))<>6 THEN C$=CHR$(3)+C$:CLOSE 1:RETURN
2200 K:=ASC(RIGHT$(C$,1))+256!+ASC(RIGHT$(C$,2)):C$=LEFT$(C$,LEN(C$)-2)
2210 CALL CRC(C$,SMZ):IF SMZ<0 THEN SQ$=SMZ+65536! ELSE SQ$=SMZ
2220 IF K!=SQ! THEN C$=CHR$(4)+C$ ELSE C$=CHR$(5)+C$
2230 CLOSE 1:RETURN
3000 REM *****
3010 REM STATUS CHECK/DISPLAY SUBROUTINE
3020 REM -REQUIRES DIRECT (C$) FROM COMMAND I/O SUBROUTINE

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3030 REM -RETURNS SST=1 FOR STATUS OK SST=0 FOR BAD STATUS
3040 REM (NOT VALID IF AUTO-CHECK ENTRY POINT NOT USED)
3050 REM *****
3060 REM THIS ENTRY FOR AUTO-CHECKING OF STATUS BYTES
3070 IF ((ASC(MID$(C$,6,1))AND 239)=136)AND(ASC(MID$(C$,7,1))=0)AND(ASC(MID$(C$,8,1))MOD 16=0)AND((ASC(MID$(C$,9,1))AND 251)=0) THEN SST=
1 ELSE SST=0
3080 RETURN
3090 REM THIS ENTRY POINT FOR STATUS DISPLAY
3100 VIEW PRINT:CLS:PRINT " ***** EWR - 84R RECORDER STATUS CHECK ***** "
3110 PRINT CHR$(201)+STRING$(77,205)+CHR$(187)
3120 RESTORE 3400:READ A$,B$:PRINT CHR$(186)+" ";:COLOR 0,7:PRINT LEFT$(A$+STRING$(37,32),35);:COLOR 7,0:PRINT " ";
3130 COLOR 0,7:PRINT LEFT$(B$+STRING$(37,32),35);:COLOR 7,0:PRINT " "+CHR$(186)
3140 PRINT CHR$(186)+" "+STRING$(37,196)+" "+STRING$(37,196)+" "+CHR$(186)
3150 FOR IQ=1 TO 8:READ A$,B$:N$=CHR$(186)+" "
3160 IF (ASC(MID$(C$,6,1))AND 2^(8-IQ)) THEN N$=N$+" >1 " ELSE N$=N$+" 0 "
3170 N$=N$+LEFT$(A$+STRING$(38,32),33)
3180 IF (ASC(MID$(C$,7,1))AND 2^(8-IQ)) THEN N$=N$+" >1 " ELSE N$=N$+" 0 "
3190 N$=N$+LEFT$(B$+STRING$(37,32),33)+CHR$(186)
3200 PRINT N$:NEXT IQ:PRINT CHR$(186)+STRING$(77,32)+CHR$(186)
3210 READ A$,B$:PRINT CHR$(186)+" ";:COLOR 0,7:PRINT LEFT$(A$+STRING$(37,32),35);:COLOR 7,0:PRINT " ";:COLOR 0,7
3220 PRINT LEFT$(B$+STRING$(37,32),35);:COLOR 7,0:PRINT " "+CHR$(186)
3230 PRINT CHR$(186)+" "+STRING$(37,196)+" "+STRING$(37,196)+" "+CHR$(186)
3240 FOR IQ=1 TO 8:READ A$:N$=CHR$(186)+STRING$(39,32)
3250 IF (ASC(MID$(C$,9,1))AND 2^(8-IQ)) THEN N$=N$+" >1 " ELSE N$=N$+" 0 "
3260 PRINT N$+LEFT$(A$+STRING$(33,32),33)+CHR$(186)
3270 NEXT IQ:ID=ASC(MID$(C$,8,1))
3280 PRINT CHR$(200)+STRING$(77,205)+CHR$(188);
3290 IF INT(IQ/64)=1 THEN PX=2 ELSE IF INT(IQ/64)=2 THEN PX=6 ELSE PX=12
3300 LOCATE 16,3:PRINT STR$(PX)+" PAGE COMMUNICATIONS BUFFER"
3310 LOCATE 18,4:PX=IQ AND 7 : ON PX+1 GOTO 3320,3330,3340,3350,3360,3370,3370,3370
3320 PRINT " ACK BLOCK RETURNED, NO ERROR":GOTO 3380
3330 PRINT "> RECORDER IN COLD/RESTART MODE":GOTO 3380
3340 PRINT "> INVALID FUNCTION/REQUEST":GOTO 3380
3350 PRINT "> RECORDER NOT IN DATA MODE":GOTO 3380
3360 PRINT "> INVALID TIME CHANGE REQUEST":GOTO 3380
3370 PRINT "> UNDEFINED ERROR"
3380 LOCATE 22,8:COLOR 16,7: PRINT " PRESS ANY KEY TO RETURN ";:COLOR 7,0
3390 IF INKEY$="" THEN 3390 ELSE RETURN
3400 DATA "1. BUBBLE MEMORY STATUS REGISTER","2. BUBBLE MEMORY ERROR REGISTER"
3410 DATA "LAST COMMAND FINISHED EXECUTION","PARITY ERROR ON LAST ACCESS"
3420 DATA "CARTRIDGE READY TO ACCEPT DATA","SPECIAL COMMAND NOT ALLOWED"
3430 DATA "CARTRIDGE READY TO SEND DATA","PAGE REFERENCE OUT OF RANGE"
3440 DATA "SPECIAL COMMANDS ARE ENABLED","CONTROLLER - CARTRIDGE CRC ERROR"
3450 DATA "A CARTRIDGE IS PRESENT","BUBBLE DATA NOT READ IN TIME"
3460 DATA "CARTRIDGE IS WRITE PROTECTED","MORE THAN 8 BAD DATA LOOPS"
3470 DATA "ERROR BITS SET ON LAST ACCESS","MARKER BIT NOT FOUND"
3480 DATA "BUBBLE MEMORY BEING ACCESSED","UNDEFINED COMMAND TO CONTROLLER"
3490 DATA "3. MAX BLOCK CODES","4. RECORDER STATUS REGISTER"
3500 DATA "BUBBLE MEMORY ERROR","BATTERY FAILURE"
3510 DATA "RAM CHECKSUM ERROR","*** THIS FLAG NOT USED"
3520 DATA "HARDWARE CLOCK FAILURE","RECORDER IN COLD/RESTART MODE"
3530 DATA "NO CARTRIDGE IN RECORDER","CARTRIDGE IS FROZEN"
4000 REM *****
4010 REM PRINT TITLE BLOCK ROUTINE
4020 REM *****
4030 VIEW PRINT:CLS:PRINT CHR$(201)+STRING$(77,205)+CHR$(187):PRINT SB$
4040 PRINT CHR$(200)+STRING$(77,205)+CHR$(188):PRINT:RETURN
5000 REM *****
5010 REM RECORDER ON-LINE? SUBROUTINE
5020 REM *****

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5030 GOSUB 4000:PRINT "IS THE RECORDER ON LINE ALREADY ? (Y/N OR A TO ABORT) ";
5040 ON INSTR(" YNA",INKEY$)+1 GOTO 5040,5040,5060,5050,5070
5050 PRINT:PRINT:INPUT "CALL THE RECORDER PRESS ENTER WHEN READY...",H$
5060 H$="X":RETURN
5070 H$="A":RETURN
6000 REM *****
6010 REM STATUS CHECK FOR READ RECORDER DATA ROUTINE
6020 REM *****
6030 PRINT:PRINT "DOING A STATUS CHECK ...":PRINT
6040 C$=REQ$(1):GOSUB 2000:IF ASC(C$)=4 THEN 6070
6050 GOSUB 7000:IF RET$="Y" THEN 6040
6060 INPUT "COMMUNICATIONS ERROR, PRESS ENTER TO RETURN",H:RETURN
6070 GOSUB 3060:IF SST THEN RETURN
6080 PRINT "STATUS ERROR, RECORDER NOT READY: DISPLAY STATUS CODES ? (Y/N)"
6090 ON INSTR(" YN",INKEY$)+1 GOTO 6090,6090,6100,6120
6100 GOSUB 3090:GOSUB 4000:PRINT "SEND STATUS REQUEST AGAIN ? (Y/N)"
6110 ON INSTR(" YN",INKEY$)+1 GOTO 6110,6110,6040,6120
6120 SST=0:RETURN
7000 REM *****
7010 REM CHECK DATA RETURNED DATA FOR ERROR CODES
7020 REM *****
7030 ON ASC(C$) GOTO 7040,7050,7060,7110,7070
7040 PRINT "RECORDER DOES NOT RESPOND TO REQUEST":GOTO 7080
7050 PRINT "BUFFER OVERFLOW/ COMMUNICATIONS ERROR":GOTO 7080
7060 GOSUB 3090:GOSUB 4000:PRINT:PRINT "NAK BLOCK RECIEVED / COMMUNICATIONS ERROR":GOTO 7080
7070 PRINT "CRC CHECKSUM ERROR / COMMUNICATIONS ERROR"
7080 PRINT " ... TRY AGAIN (Y/N) ?"
7090 ON INSTR(" YN",INKEY$)+1 GOTO 7090,7090,7100,7110
7100 RET$="Y":RETURN
7110 RET$="N":RETURN
8000 REM *****
8010 REM START OF MAIN MENU OPTION 1. ROUTINE RETRIEVAL & TRANSLATION
8020 REM - OPENS AND CLOSSES 'COM1' FILES (#1)
8030 REM - OPENS, WRITES TO, AND CLOSSES DISK FILE (#2)
8040 REM - PARTIAL READ, REQUIRES LAST PAGE REFERENCED FROM FILE 'UPDATE.EMR'
8050 REM *****
8060 SB$=CHR$(186)+" 1. E M R - 8 4 R R O U T I N E D A T A C O L L E C T I O N (R F F I L E) "+CHR$(186)
8070 GOSUB 5000:IF ASC(H$)=65 THEN 1000 ELSE 8220
8080 VT$=V$:V$="":FOR IV=1 TO LEN(VT$)/3:A1$=RIGHT$("00"+HEX$(ASC(MID$(VT$,IV*3-2,1))),2)
8090 A2$=RIGHT$("00"+HEX$(ASC(MID$(VT$,IV*3-1,1))),2):A3$=RIGHT$("00"+HEX$(ASC(MID$(VT$,IV*3,1))),2)
8100 V$=V$+A1$+RIGHT$(A2$,1)+LEFT$(A2$,1)+A3$:NEXT IV:RETURN
8110 C$="COMMUNICATIONS ERROR, READ ABORTED":GOTO 8130
8120 C$="START MARKER NOT FOUND, READ ABORTED"
8130 GOSUB 4000:PRINT C$:PRINT:CLOSE 2:KILL WRF$
8140 INPUT "PRESS ENTER TO RETURN TO MAIN MENU ",H:GOTO 1000
8150 GOSUB 4000:PRINT "TRANSFER COMPLETE ...":PRINT:CLOSE 2
8160 IV=WW+IW-1003:UP$=LEFT$(UP$,2)+CHR$(IV MOD 256)+CHR$(INT(IV/256))
8170 OPEN "O",#2,"UPDATE.EMR":PRINT #2,UP$:CLOSE 2:GOTO 8140
8180 FOR IW=1 TO LEN(V$)/3:L$=MID$(V$,IW*3-2,3):IF (L$="FFE") OR (L$="FFF") THEN 8190 ELSE PRINT #2,L$:GOTO 8200
8190 QX=INT((WW+IW-1)*1.5/32):IF (QX=NPR) OR (QX=NPR+1) THEN IW=1000+IW ELSE PRINT #2,L$:
8200 NEXT IW:IF IW<400 THEN RET$="N" ELSE RET$="D"
8210 RETURN
8220 WW=ASC(MID$(UP$,3,1))+ASC(RIGHT$(UP$,1))*256
8230 GOSUB 11000:IF SST=0 THEN 1000 ELSE V$=C$:GOSUB 12000:IF SST=0 THEN 1000 ELSE C$=V$
8240 GOSUB 4000:PRINT "RETRIEVING DATA ...":PRINT:NPR=ASC(MID$(C$,10,1))+ASC(MID$(C$,11,1))*256:PRINT NPR
8250 C$=REQ$(7):MID$(C$,5,4)=CHR$(0)+CHR$(0)+CHR$(3)+CHR$(0):GOSUB 2000
8260 IF ASC(C$)>4 THEN GOSUB 7000:IF RET$="Y" THEN 8250 ELSE 1000
8270 B$=DATE$:WRF$="RF"+MID$(B$,4,2)+LEFT$(B$,2)+RIGHT$(B$,2)+"*.EMR"
8280 OPEN "O",#2,WRF$:V$=MID$(C$,6,96):GOSUB 8080
8290 PRINT #2,LEFT$(V$,150);

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0400 MM=MM-59:IF MM<50 THEN MM=MM+21794
0410 SPR=INT((MM+1.5)/96)*3:IF SPR=1023 THEN 0460
0420 C$=REQ$(7):MID$(C$,5,4)=CHR$(SPR MOD 256)+CHR$(INT(SPR/256))+CHR$(3)+CHR$(0):GOSUB 2000
0430 IF ASC(C$)=4 THEN 0440 ELSE GOSUB 7000:IF RET$="Y" THEN 0420 ELSE 0110
0440 V$=MID$(C$,6,96):GOSUB 8000:V$=RIGHT$(V$,192-(MM MOD 64)*3):GOSUB 8100
0450 MM=MM+LEN(V$)/3:GOTO 0500
0460 C$=REQ$(7):MID$(C$,5,4)=CHR$(255)+CHR$(3)+CHR$(1)+CHR$(0):GOSUB 2000
0470 IF ASC(C$)=4 THEN 0480 ELSE GOSUB 7000:IF RET$="Y" THEN 0460 ELSE 0110
0480 V$=MID$(C$,6,33):GOSUB 8000:V$=LEFT$(V$,63)
0490 V$=RIGHT$(V$, (MM-INT(SPR*32/1.5)+1)*3):GOSUB 8100:MM=50:GOTO 0550
0500 IW=INT(MM/64)*3:PRINT CHR$(30)+"NOW ON PAGE ";IW;" ":IF MM<21024 THEN 0590
0510 C$=REQ$(7):MID$(C$,5,4)=CHR$(255)+CHR$(3)+CHR$(1)+CHR$(0):GOSUB 2000
0520 IF ASC(C$)=4 THEN 0530 ELSE GOSUB 7000:IF RET$="Y" THEN 0510 ELSE 0110
0530 V$=MID$(C$,6,33):GOSUB 8000:V$=LEFT$(V$,63):GOSUB 8100
0540 IF RET$="D" THEN 0150
0550 C$=REQ$(7):MID$(C$,5,4)=CHR$(0)+CHR$(0)+CHR$(3)+CHR$(0):GOSUB 2000
0560 IF ASC(C$)=4 THEN 0570 ELSE GOSUB 7000:IF RET$="Y" THEN 0550 ELSE 0110
0570 V$=MID$(C$,6,14):GOSUB 8000:GOSUB 8100:IF RET$="D" THEN 0150
0580 MM=64:GOTO 0500
0590 C$=REQ$(7):SPR=INT(MM/64)*3:MID$(C$,5,4)=CHR$(SPR MOD 256)+CHR$(INT(SPR/256))+CHR$(3)+CHR$(0):GOSUB 2000
0600 IF ASC(C$)=4 THEN 0610 ELSE GOSUB 7000:IF RET$="Y" THEN 0590 ELSE 0110
0610 V$=MID$(C$,6,96):GOSUB 8000:GOSUB 8100:IF RET$="D" THEN 0150
0620 MM=MM+64:GOTO 0500
9000 REM *****
9010 REM START OF MAIN MENU OPTION 2 -RECORDER ACCESS
9020 REM *****
9030 SB$=CHR$(186)+" 2. E M R - 0 4 R D I R E C T A C C E S S : I N S P E C T / A L T E R "+CHR$(186):GOSUB 5000
9040 IF ASC(H$)=65 THEN 1000
9050 VIEW PRINT:CLS:PRINT CHR$(201)+STRING$(77,205)+CHR$(187)
9060 PRINT CHR$(186)+" 2. E M R - 0 4 R D I R E C T A C C E S S : I N S P E C T / A L T E R "+CHR$(186)
9070 PRINT CHR$(186)+STRING$(77,196)+CHR$(186)
9080 PRINT CHR$(186)+" S E L E C T : 1 = STATUS CHECK / SELF TEST "+CHR$(186)
9090 PRINT CHR$(186)+" 2 = READ RECORDER HEADER, CONFIGURATION RAM, DATA "+CHR$(186)
9100 PRINT CHR$(186)+" 3 = RESET RECORDER TIME (WRITES MARKER RECORD) "+CHR$(186)
9110 PRINT CHR$(186)+" 4 = RECONFIGURE RECORDER PARAMETERS (DESTROYS DATA) "+CHR$(186)
9120 PRINT CHR$(186)+" 5 = INITIALIZE BUBBLE MEMORY (DESTROYS PRESENT DATA) "+CHR$(186)
9130 PRINT CHR$(186)+" 6 = SUSPEND / RESUME DATA COLLECTION "+CHR$(186)
9140 PRINT CHR$(186)+" 7 = RETURN TO PROGRAM MAIN MENU "+CHR$(186)
9150 PRINT CHR$(186)+STRING$(77,32)+CHR$(186)
9160 PRINT CHR$(186)+" PRESS APPROPRIATE KEY TO START FUNCTION..... "+CHR$(186)
9170 PRINT CHR$(2001)+STRING$(77,205)+CHR$(188):VIEW PRINT 15 TO 24
9180 ON INSTR(" 1234567",INKEY$)+1 GOTO 9180,9180,10000,13000,18000,19000,9180,9180,1000
10000 REM *****
10010 REM START MENU 2, OPTION 1: STATUS REQUEST
10020 REM *****
10030 SB$=CHR$(186)+" 2. E M R - 0 4 R D I R E C T A C C E S S : 2.1 - STATUS REQUEST "+CHR$(186)
10040 PRINT:PRINT "SENDING STATUS REQUEST .....":C$=REQ$(1):GOSUB 2000
10050 IF ASC(C$)=4 THEN GOSUB 3090:GOTO 9050:ELSE GOSUB 7000:IF RET$="Y" THEN GOSUB 4000:GOTO 10040 ELSE 9050
11000 REM *****
11010 REM WRITE MARKER
11020 REM *****
11030 GOSUB 6000:IF SST=0 THEN RETURN
11040 PRINT:PRINT "WRITING MARKER RECORD .....":C$=REQ$(3):GOSUB 2000:IF ASC(C$)=4 THEN SST=1:RETURN
11050 GOSUB 7000:IF RET$="Y" THEN GOSUB 4000:GOTO 11040 ELSE SST=0:RETURN
12000 REM *****
12010 REM SEND SIGN-OFF
12020 REM *****
12030 PRINT:PRINT "SENDING SIGN-OFF COMMAND ...":C$=REQ$(5):GOSUB 2000:IF ASC(C$)=4 THEN SST=1:RETURN
12040 GOSUB 7000:IF RET$="Y" THEN GOSUB 4000:GOTO 12030 ELSE SST=0:RETURN
13000 REM *****

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13010 REM START MENU 2, OPTION 2: READ RECORDER CONSTANTS
13020 REM *****
13030 SB$=CHR$(186)+" 2. EWR - B A R D I R E C T A C C E S S : 2.2 - READ RECORDER INFO "+CHR$(186)
13040 GOSUB 4000:PRINT:PRINT "          SELECT : 1 = HEADER RECORD:PRINT "          2 = CONFIGURATION RAM"
13050 PRINT "          3 = BUBBLE MEMORY CARTRIDGE"
13060 PRINT "          4 = DUMP ALL OF BUBBLE MEMORY TO DISK"
13070 PRINT "          5 = RETURN TO MENU 2"
13080 ON INSTR "12345",INKEY$+1 GOTO 13080,13080,14000,15000,16000,17000,9050
14000 REM *****
14010 REM START MENU 2, OPTION 2.1 : READ HEADER
14020 REM *****
14030 SB$=CHR$(186)+" 2. EWR - B A R D I R E C T A C C E S S : 2.2.1 -READ HEADER "+CHR$(186)
14040 GOSUB 6000:IF SST=0 THEN 9050
14050 PRINT:PRINT "SENDING READ HEADER REQUEST ...":C$=REQ$(7):MID$(C$,5,4)=CHR$(0)+CHR$(0)+CHR$(3)+CHR$(0):GOSUB 2000
14060 IF ASC(C$)<4 THEN GOSUB 7000:IF RET$="Y" THEN GOSUB 4000:GOTO 14050 ELSE 9050
14070 RESTORE 14110:C$=MID$(C$,6,75):VIEW PRINT:CLS:D$=""
14080 FOR IQ=1 TO 25:A1$=RIGHT$("00"+HEX$(ASC(MID$(C$,IQ+3,1))),2)
14090 A2$=RIGHT$("00"+HEX$(ASC(MID$(C$,IQ+3-1,1))),2):A3$=RIGHT$("00"+HEX$(ASC(MID$(C$,IQ+3,1))),2)
14100 D$=D$+A1$+RIGHT$(A2$,1)+LEFT$(A2$,1)+A3$:NEXT IQ
14110 DATA "CARTRIDGE SERIAL NUMBER",2,3,"MEMORY TYPE: 1=BUBBLE 2=EEPROM",5,1
14120 DATA "COUNT OF REVISIONS IN RAM",7,1,"ID CODE",8,14
14130 DATA "INTERVAL DEFINITION",22,1,"ACTIVE CHANNEL DESIGNATOR",23,1
14140 DATA "MINIMUM REPORTABLE OUTAGE (SEC)",25,1,"INTERVAL LENGTH",36,1
14150 DATA "SIZE OF DATA RAM (1K BLOCKS)",37,1,"SOFTWARE SPEC. NO.",39,5
14160 DATA "INSTALLATION TIME SSMHHH",44,3,"INSTALLATION DATE DDMYY",47,2
14170 GOSUB 4000:PRINT:PRINT " CARTRIDGE HEADER RECORD..":PRINT
14180 FOR IQ=1 TO 11:READ A$,A,B:PRINT RIGHT$(STRING$(40,32)+A$,40)+" : ";
14190 FOR JQ=0 TO B-1:PRINT MID$(D$,A+3-1+JQ*3,2):NEXT JQ:PRINT:NEXT IQ
14200 READ A$,A,B:PRINT RIGHT$(STRING$(40,32)+A$,40)+" : ";
14210 PRINT MID$(D$,A+3-1,2)+RIGHT$(STR$(VAL("HH"+MID$(D$,A+3+2,1))),2);
14220 IYR=VAL(RIGHT$(DATE$,2)):MYR=IYR MOD 4:ILP=INT(VAL("HH"+MID$(D$,A+3+1,1))/64)
14230 YR=IYR-MYR+ILP:IF YR>IYR THEN YR=YR-4
14240 PRINT RIGHT$(STR$(YR),2)
14250 PRINT:INPUT "PRESS ENTER TO RETURN TO DIRECT ACCESS MENU 2 ",H:GOTO 9050
15000 REM *****
15010 REM START MENU 2, OPTION 2.2 :CONFIGURATION REQUEST
15020 REM *****
15030 SB$=CHR$(186)+" 2. EWR - B A R D I R E C T A C C E S S : 2.2.2 -CONFIGURATION RAM "+CHR$(186)
15040 PRINT:PRINT "SENDING CONFIGURATION DATA REQUEST ...":C$=REQ$(8):GOSUB 2000
15050 IF ASC(C$)<4 THEN GOSUB 7000:IF RET$="Y" THEN GOSUB 4000:GOTO 15000 ELSE 9050
15060 RESTORE 15080:D$=MID$(C$,6,70):VIEW PRINT:GOSUB 4000
15070 PRINT:PRINT "RECORDER CONFIGURATION DATA":PRINT
15080 DATA "RECORDER TIME SSMHHH",1,3,"RECORDER DATE DDMYY",4,3
15090 DATA "TOTAL PULSES CHANNEL A",7,4,"TOTAL PULSES CHANNEL B",11,4
15100 DATA "TOTAL PULSES CHANNEL C",15,4,"TOTAL PULSES CHANNEL D",19,4
15110 DATA "RECORDER ID",23,14,"MIN. REPORTABLE OUTAGE (SEC)",37,2
15120 DATA "COUNT OF RAM REVISIONS",39,1,"INTERVAL LENGTH (MINS)",40,1
15130 DATA "ACTIVE CHANNELS",41,1,"RELAY AND LAMP STATUS BYTE",44,1
15140 DATA "CARTRIDGE CHANGE STEP 0",45,1,"ANSWER WINDOW (HHMM TO HHMM)",46,4
15150 C$="DDDDDDADBBBBDD"
15160 FOR IQ=1 TO 14:READ A$,A,B:PRINT RIGHT$(STRING$(40,32)+A$,40)+" : ";
15170 C$=MID$(D$,A,B):IF MID$(C$,IQ,1)="A" THEN PRINT C$:GOTO 15200
15180 IF MID$(C$,IQ,1)="B" THEN PRINT HEX$(ASC(C$)):GOTO 15200
15190 FOR JQ=1 TO B:PRINT RIGHT$("00"+HEX$(ASC(MID$(C$,JQ,1))),2):NEXT JQ:PRINT
15200 NEXT IQ:PRINT:INPUT "PRESS ENTER TO RETURN TO DIRECT ACCESS MENU 2 ",H:GOTO 9050
16000 REM *****
16010 REM START MENU 2, OPTION 2.3 :READ RECORDER DATA
16020 REM *****
16030 SB$=CHR$(186)+" 2. EWR - B A R D I R E C T A C C E S S : 2.2.3 -READ BUBBLE MEM. "+CHR$(186)
16040 GOSUB 4000:PRINT:PRINT "DOING STATUS CHECK"

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16050 C8=REQ$(1):GOSUB 2000:IF ASC(C8)=4 THEN 16060 ELSE GOSUB 7000:IF RET8="Y" THEN 16040 ELSE GOTO 9050
16060 IF ((ASC(MID$(C8,6,1))AND 239)=136)AND(ASC(MID$(C8,8,1))MOD 16=0)AND((ASC(MID$(C8,9,1))AND 251)=0) THEN 16090
16070 PRINT:PRINT "STATUS ERROR, DISPLAY STATUS CODES ? (Y/N)":GOSUB 7090:IF RET8="Y" THEN 16080 ELSE 9050
16080 GOSUB 3090:GOSUB 4000:PRINT:GOSUB 7000:IF RET8="Y" THEN 16040 ELSE 9050
16090 GOSUB 4000:PRINT:PRINT "READ BUBBLE MEMORY CARTRIDGE: READS 3 PAGES AT A TIME (64 12-BIT VALUES)":PRINT
16100 PRINT "THE PROGRAM ROUNDS DOWN A PAGE REQUEST TO THE NEXT LOWEST 3 PAGE BLOCK, WITH":PRINT
16110 PRINT "THE LAST PAGE (1023) BEING READ AS A SINGLE PAGE ONLY":PRINT
16120 INPUT "ENTER PAGE TO VIEW (0-1023) ",P6
16130 IF (P6<0 OR (P6>1023)) THEN DEEP:PRINT CHR$(30)+STRING$(77,32):PRINT CHR$(30):GOTO 16120
16140 IF P6=1023 THEN PRINT:PRINT "SENDING REQUEST FOR PAGE 1023":GOTO 16240
16150 P6=INT(P6/3)*3:PRINT:PRINT "SENDING BLOCK REQUEST, PAGES":P6;" TO":P6+2
16160 C8=REQ$(7):MID$(C8,5,4)=CHR$(P6 MOD 256)+CHR$(INT(P6/256))+CHR$(3)+CHR$(0):GOSUB 2000:IF ASC(C8)=4 THEN 16180
16170 GOSUB 4000:GOSUB 7000:IF RET8="Y" THEN 16160 ELSE 9050
16180 D8="":FOR I0=1 TO 32:A18=RIGHT$( "00"+HEX$(ASC(MID$(C8,I0*3+3,1))),2)
16190 A28=RIGHT$( "00"+HEX$(ASC(MID$(C8,I0*3+4,1))),2):A38=RIGHT$( "00"+HEX$(ASC(MID$(C8,I0*3+5,1))),2)
16200 D8=D8+A18+RIGHT$(A28,1)+LEFT$(A28,1)+A38:NEXT I0
16210 GOSUB 4000:PRINT:PRINT "BLOCK OF PAGES ";P6;" TO ";P6+2:PRINT
16220 FOR I0=0 TO 7:PRINT " ";:FOR J0=1 TO 8:PRINT MID$(D8,I0*24+J0*3-2,3)+ " ";:NEXT J0:PRINT:NEXT I0
16230 PRINT:PRINT "ANOTHER BLOCK OF PAGES ? (Y/N)":GOSUB 7090:IF RET8="Y" THEN PRINT:GOTO 16120 ELSE 9050
16240 C8=REQ$(7):MID$(C8,5,4)=CHR$(255)+CHR$(3)+CHR$(1)+CHR$(0):GOSUB 2000:IF ASC(C8)=4 THEN C8=C8+" ":GOTO 16260
16250 GOSUB 4000:GOSUB 7000:IF RET8="Y" THEN 16240 ELSE 9050
16260 D8="":FOR I0=1 TO 11:A18=RIGHT$( "00"+HEX$(ASC(MID$(C8,I0*3+3,1))),2)
16270 A28=RIGHT$( "00"+HEX$(ASC(MID$(C8,I0*3+4,1))),2):A38=RIGHT$( "00"+HEX$(ASC(MID$(C8,I0*3+5,1))),2)
16280 D8=D8+A18+RIGHT$(A28,1)+LEFT$(A28,1)+A38:NEXT I0:D8=LEFT$(D8,63)+STRING$(9,32)
16290 GOSUB 4000:PRINT:PRINT "PAGE 1023":PRINT
16300 FOR I0=0 TO 3:PRINT " ";:FOR J0=1 TO 8:PRINT MID$(D8,I0*24+J0*3-2,3)+ " ";:NEXT J0:PRINT:NEXT I0:GOTO 16230
17000 REM *****
17010 REM START MENU 2, OPTION 2.2.4 : DUMP MEM
17020 REM *****
17030 SB8=CHR$(186)+" 2. E M R - 8 4 R D I R E C T A C C E S S : 2.2.4 -DUMP BUBBLE MEM. "+CHR$(186):GOSUB 4000
17040 PRINT:PRINT "ENTER 5 CHARACTER FILE NAME FOR DUMP (NO EXTENSION)"
17050 INPUT " " > " ,F8:F8=RIGHT$( " " +F8+"EMR",8):OPEN "0",0,F8+" .DMP"
17060 FOR P6=0 TO 1014 STEP 6:PRINT "DOING PAGES":P6;" TO":P6+5:CHR$(30)
17070 C8=REQ$(7):MID$(C8,5,4)=CHR$(P6-INT(P6/256)*256)+CHR$(INT(P6/256))+CHR$(6)+CHR$(0)
17080 GOSUB 2000:IF ASC(C8)=4 THEN 17100 ELSE GOSUB 7000
17090 IF RET8="Y" THEN 17070 ELSE P6=2000:GOTO 17130
17100 FOR PY=0 TO 63:A18=RIGHT$( "00"+HEX$(ASC(MID$(C8,6+PY*3,1))),2)
17110 A28=RIGHT$( "00"+HEX$(ASC(MID$(C8,7+PY*3,1))),2):A38=RIGHT$( "00"+HEX$(ASC(MID$(C8,8+PY*3,1))),2)
17120 PRINT 02,A18+RIGHT$(A28,1)+LEFT$(A28,1)+A38:NEXT PY
17130 NEXT P6:IF P6>1500 THEN CLOSE 2:STOP
17140 C8=REQ$(7):MID$(C8,5,4)=CHR$(252)+CHR$(3)+CHR$(4)+CHR$(0)
17150 GOSUB 2000:IF ASC(C8)=4 THEN 17170 ELSE GOSUB 7000
17160 IF RET8="Y" THEN 17140 ELSE CLOSE 2:STOP
17170 C8=MID$(C8,6,128)+CHR$(0)
17180 FOR PY=0 TO 42:A18=RIGHT$( "00"+HEX$(ASC(MID$(C8,PY*3+1,1))),2)
17190 A28=RIGHT$( "00"+HEX$(ASC(MID$(C8,PY*3+2,1))),2):A38=RIGHT$( "00"+HEX$(ASC(MID$(C8,PY*3+3,1))),2)
17200 PRINT 02,A18+RIGHT$(A28,1)+RIGHT$(A28,1)+A38:NEXT PY
17210 CLOSE 2:PRINT "TRANSFER COMPLETED....":GOTO 9050
18000 REM *****
18010 REM START MENU 2, OPTION 3 : RESET TIME
18020 REM *****
18030 SB8=CHR$(186)+" 2. E M R - 8 4 R D I R E C T A C C E S S : 2.3 -RESET RECORDER TIME "+CHR$(186):GOSUB 4000
18040 PRINT:"THE RECORDER MUST BE IN COLD START MODE FIRST! (CART. CHG STEP=3)":PRINT
18050 PRINT:"READY ? (Y/N)":GOSUB 7090:IF RET8="N" THEN 9050
18060 C8=REQ$(10):GOSUB 2000:IF ASC(C8)=4 THEN 18080
18070 GOSUB 7000:IF RET8="Y" THEN 18050 ELSE 9050
18080 C8=CHR$(2)+CHR$(82)+CHR$(1)+CHR$(22)+CHR$(VAL("4H"+RIGHT$(TIME$,2)))+CHR$(VAL("4H"+MID$(TIME$,4,2)))+CHR$(VAL("4H"+LEFT$(TIME$,2)))
18090 C8=C8+CHR$(VAL("4H"+MID$(DATE$,4,2)))+CHR$(VAL("4H"+LEFT$(DATE$,2)))+CHR$(VAL("4H"+RIGHT$(DATE$,2)))
18100 GOSUB 2000:IF ASC(C8)=4 THEN 9050
18110 GOSUB 7000:IF RET8="Y" THEN 18040 ELSE 9050

```

```

19000 REM *****
19010 REM START MENU 2, OPTION 4 : RECONFIGURE
19020 REM *****
19030 SB$=CHR$(186)+* 2. EWR - 8 4 R DIRECT ACCESS : 2.4 -RECONFIGURE DEVICE *+CHR$(186):GOSUB 4000
19040 PRINT:PRINT "ARE YOU SURE ? DATA WILL BE DESTROYED ! (Y/N)":GOSUB 7090:IF RET$="N" THEN 9050
19050 GOSUB 4000:PRINT:PRINT "SETTING RECORDER OUT OF DATA MODE ..."
19060 C$=REQ$(3):GOSUB 2000:IF ASC(C$)=4 THEN 19070 ELSE GOSUB 7000:IF RET$="Y" THEN 19060 ELSE 9050
19070 PRINT:PRINT "SUSPENDING COLLECTION ..."
19080 C$=REQ$(4):GOSUB 2000:IF ASC(C$)=4 THEN 19090 ELSE GOSUB 7000:IF RET$="Y" THEN 19080 ELSE 9050
19090 GOSUB 4000:PRINT"SELECT INTERVAL LENGTH 1 = 5 MINUTES"
19100 PRINT "                2 = 15 MINUTES":PRINT "                3 = 30 MINUTES"
19110 ON INSTR(" 123",INKEY$)+1 GOTO 19110,19110,19120,19130,19140
19120 T=5:GOTO 19150
19130 T=21:GOTO 19150
19140 T=48
19150 P$=CHR$(2)+CHR$(81)+CHR$(1)+CHR$(6)+*EWR EWR-84R -1*+CHR$(22)+CHR$(22)+CHR$(0)+CHR$(T)+STRING$(4,22)
19160 PRINT:PRINT "SENDING RECONFIGURATION REQUEST ..."
19170 C$=REQ$(9):GOSUB 2000:IF ASC(C$)=4 THEN 19180 ELSE GOSUB 7000:IF RET$="Y" THEN 19170 ELSE 9050
19180 C$=P$:GOSUB 2000:IF ASC(C$)=4 THEN 19190 ELSE GOSUB 7000:IF RET$="Y" THEN 19180 ELSE 9050
19190 PRINT:PRINT "INITIALIZING THE RECORDER ..."
19200 C$=REQ$(2):GOSUB 2000:IF ASC(C$)=4 THEN 19210 ELSE GOSUB 7000:IF RET$="Y" THEN 19200 ELSE 9050
19210 OPEN "0",#2,"UPDATE.EWR":PRINT #2,PWD$+CHR$(109)+CHR$(0):CLOSE 2:GOSUB 12000:GOTO 9050
20000 REM *****
20010 REM MAIN MENU OPTION 3: INTERPRET RAW DATA FILE : RFXXXXX.EWR
20020 REM - CREATES TFXXXXX.EWR LOTUS COMPATIBLE ASCII FILE
20030 REM *****
20032 DMT$="322932313231323231323132"
20040 SB$=CHR$(186)+* 3. EWR - 8 4 R RAW FILE TRANSLATION (RF-TF FILE) *+CHR$(186)
20050 GOSUB 4000:FILES "RF*.EWR":INPUT "ENTER FILE, NO EXTENSION ",FL$
20060 OPEN "I",#2,FL$+*.EWR":C$=INPUT$(150,2)
20070 IF LEFT$(C$,3)<"FFC" THEN PRINT "FILE INVALID, NO HEADER ...":CLOSE 2:INPUT "PRESS ENTER TO RETURN ",H:GOTO 1030
20080 IND=VAL(MID$(C$,66,1)):IF IND=0 THEN IND=5 ELSE IF IND=1 THEN IND=15 ELSE IND=30
20090 C$=INPUT$(180,2)
20100 IF LEFT$(C$,3)<"FFD" THEN PRINT "FILE INVALID, NO START MARKER ...":CLOSE 2:INPUT "PRESS ENTER TO RETURN ",H:GOTO 1030
20110 T$=MID$(C$,7,15):GOSUB 20120:GOSUB 20160:GOTO 20200
20120 TS=VAL(MID$(T$,1,3)):TM=VAL(MID$(T$,4,3)):TH=VAL(MID$(T$,7,3)):TD=VAL(MID$(T$,10,3)):TMD=VAL("LM"+RIGHT$(T$,1))
20130 TY=INT(VAL("LM"+MID$(T$,14,1))/4):IYR=VAL(RIGHT$(DATE$,2)):MYR=IYR MOD 4
20140 TY=IYR-MYR+TY:IF TY>IYR THEN TY=TY-4
20150 RETURN
20160 TT$=STR$(TMD):LM=LEN(TT$):MP$=RIGHT$("00"+RIGHT$(TT$,LM-1),2):TT$=STR$(TD):LM=LEN(TT$):MP$=MP$+RIGHT$("00"+RIGHT$(TT$,LM-1),2)
20170 TT$=STR$(TY):LM=LEN(TT$):MP$=MP$+RIGHT$("00"+RIGHT$(TT$,LM-1),2):TT$=STR$(TH):LM=LEN(TT$):MP$=MP$+RIGHT$("00"+RIGHT$(TT$,LM-1),2)
20180 TT$=STR$(TM):LM=LEN(TT$):MP$=MP$+RIGHT$("00"+RIGHT$(TT$,LM-1),2):TT$=STR$(TS):LM=LEN(TT$):MP$=MP$+RIGHT$("00"+RIGHT$(TT$,LM-1),2)
20190 RETURN
20200 PP$=MP$+*,*:LCT=0
20210 IN$=INPUT$(3,2):IF IN$<"FFE" THEN PRINT "FILE INVALID, NO START DATA FLAG ...":CLOSE 2:INPUT "PRESS ENTER TO RETURN ...",H:GOTO 1030
20220 FOR IX=1 TO 4:IF LCT=1 THEN LCT=0:GOTO 20240
20230 IN$=INPUT$(3,2)
20240 IF IN$<"FE0" THEN PP$=PP$+RIGHT$(" "+STR$(VAL("LM"+IN$)),4)+*,*:GOTO 20280
20250 ON INT(INSTR(" FE0 FE4 FFD ",IN$)/4)+1 GOTO 20260,20270,20230,20230
20260 PRINT "FILE INVALID, UNEXPECTED FLAG ...":CLOSE 2:INPUT "PRESS ENTER TO RETURN ...",H:IX=20:GOTO 20280
20270 PP$=PP$+*****
20280 NEXT IX:IF IX>10 THEN GOTO 1030
20285 IN$=INPUT$(3,2):IF IN$<"FDF" THEN 20390
20290 PP$=PP$+*:PRINT PP$
20300 IF TS<>0 THEN TS=0
20310 IF TM MOD 15=0 THEN TM=TM+15 ELSE TM=TM+(15-(TM MOD 15))
20320 IF TH=60 THEN TH=0:TH=TH+1
20330 IF TH=24 THEN TH=0:TD=TD+1
20340 IF (TMD=2) AND (TY MOD 4=0) THEN 20350 ELSE 20360

```

20350 IF TD=30 THEN TMO=TMO+1:GOTO 20370
20360 IF TD=VAL(MID\$(DNT\$,TMO*2-1,2))THEN TMO=TMO+1
20370 IF TMO=13 THEN TMO=1:TY=TY+1
20380 GOSUB 20160:LCT=1:PP\$=MP\$+" ":GOTO 20220
20390 ON INT(INSTR(" FE1 FE4 FE6 FFA FFB ",IN\$)/4)+1 GOTO 20400,20410,20285,20420,20440,20285
20400 PRINT "FILE INVALID, UNEXPECTED FLAG ...":CLOSE 2:INPUT "PRESS ENTER TO RETURN ...":H:GOTO 1030
20410 PP\$=PP\$+" ":PRINT PP\$:GOTO 20285
20420 PP\$=PP\$+" ":PRINT PP\$:IN\$=INPUT\$(3,2):IF IN\$="FFA" THEN C\$=INPUT\$(36,2) ELSE C\$=INPUT\$(12,2)
20430 T\$=INPUT\$(15,2):GOSUB 20120:GOSUB 20160:PP\$=MP\$+" ":LCT=0:GOTO 20220
20440 IN\$=INPUT\$(3,2):PP\$=PP\$+" ":PRINT PP\$
20450 IN\$=INPUT\$(3,2):ON INT(INSTR(" FE4 FFB FFD FFE ",IN\$)/4)+1 GOTO 20400,20450,20450,20460,20300
20460 T\$=INPUT\$(177,2)
20470 T\$=MID\$(T\$,4,15):GOSUB 20120:GOSUB 20160
20480 IF EOF(2) THEN PP\$=MP\$+" , , , , , ":PRINT PP\$ ELSE GOTO 20220
20490 PRINT:PRINT "INTERPRETATION COMPLETE ...":INPUT "PRESS ENTER TO RETURN ...":H:CLOSE 2:GOTO 1030

```

DGROUP    GROUP    CONST,DATA
          ASSUME    CS:BC_CODE,DS:DGROUP

```

```

; Program = CRC.ASM

```

```

; Date = 2-March-87

```

```

; 8086 assembly language routine for C697 checksum calculation

```

```

CONST     SEGMENT PUBLIC 'RT_DATA'
CONST     ENDS

```

```

DATA      SEGMENT PUBLIC 'DATA'
EOF        DW      0

```

```

icrc      dw      0

```

```

shft      dw      0

```

```

gates     dw      0

```

```

prld      dw      0

```

```

poly      dw      0

```

```

polyad    dw      0

```

```

LGT        DW      0

```

```

FPOINT     DW      0

```

```

SAVA       DW      0

```

```

CHKSUM     DW      0

```

```

DATBYT     DB      0

```

```

DATA      ENDS

```

```

BC_CODE    SEGMENT PUBLIC 'CODE'
          PUBLIC    crc

```

```

; PROCEDURE crc

```

```

; 19-MAR-87

```

```

; WILL OPEN A FILE FOR USE IN ASSEMBLY LANGUAGE
; ROUTINE USING DOS.

```

```

; CALL crc WITH A STRING VARIABLE COM$
; RETURN WITH RESULT IN CKSUM%

```

```

; e.g. CALL crc (COM$,CKSUM%)

```

```

crc        PROC      FAR

```

```

          POP        AX

```

```

          POP        BX

```

```

          POP        EOF

```

```

          POP        DX

```

```

          PUSH       BX

```

```

          PUSH       AX

```

```

          MOV        SI,DX

```

```

          MOV        AX,[SI]

```

```

          MOV        LGT,AX

```

```

          ADD        SI,2

```

```

          MOV        AX,[SI]

```

```

          MOV        DX,840BH

```

```

          mov        poly,dx

```

```

          MOV        FPOINT,AX

```

```

          mov        ax,0

```

```

          mov        chksum,ax

```

```

DVIDE:     MOV        BX,FPOINT

```

```

          mov        cx,lgT

```

```

calc:      mov        al,[bx]

```

```

          mov        datbyt,al

```

```

; POP OFF RETURN ADDRESS
; IT IS A FAR RETURN

```

```

; POP POINTER TO STRING
; RESTORE RETURN ADDRESS

```

```

; GET LENGTH OF STRING
; STRING VARIABLE
; ADD 2 FOR ADDRESS POINTER
; GET POINTER TO STRING
; POLYNOMIAL

```

```

; STRING VARIABLE

```

```

call    far ptr gencrc
inc     bx
loop    calc
mov     ax,chksum
mov     cx,16
flip:   rcl     ax,1
        rcr     bx,1
        loop    flip
        mov     ax,bx
        mov     bx,eof
        mov     [bx],ax
        ret
crc      endp
gencrc   proc    far
        push    cx
        push    bx
        mov     dx,chksum
        mov     cx,8                ; 8 bits to process
        mov     datbyt,al
nxbit:   mov     al,databyt
        rol     al,1
        mov     ah,al
        mov     datbyt,al
        xor     ah,d1
        and     ah,1
        jz      notal
        mov     word ptr gates,0ffffh
        jmp     doit
notal:   mov     word ptr gates,0
doit:    mov     ax,word ptr gates
        and     ax,poly
        mov     shift,ax
        mov     ax,dx
        shr     ax,1
        xor     ax,shift
        mov     dx,ax
        loop    nxbit
        mov     checksum,dx
        pop     bx
        pop     cx
        RET
gencrc   endp
BC_CODE
END
ENDS
; BACK TO BASIC

```